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AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

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Directions for bending, blowing, and cutting of Glass, for chemical and other purposes. Extracted from Chemical Manipulation. By MICHAEL FARADAY, F. R. S.

[Continued from p. 99.]

21. The operation next in simplicity is bending a tube, requisite for the making of syphons, tube retorts, and tube operations of all kinds. An unpractised person will effect this most easily with a piece of tube about six or seven inches in length, half an inch in diameter, and the twelfth or fourteenth of an inch in thickness. Such a piece is easily handled, retains its heat longer than a smaller or thinner tube, and requiring more power to bend it, it is for that reason more steady in the hand. Being heated in the manner already described (3,) nothing will be found more easy than to bend it: but if this be done hastily or inattentively, the bend will be of a bad form; contracted in its channel; thin in one part and thick in another; probably wrinkled and distorted, and then very liable to crack on cooling.

22. To avoid these errors, when the glass is uniformly heated for the length of half an inch or more, and to such a degree that it is manifestly soft by the feel, it should be taken out of the flame; and the two ends being now simply inclined in opposite directions, but without any other tendency by the hand, the glass is to be bent gradually in such a direction that the convex part shall be towards the eye. The operation should be continued until the required degree of curvature or the desired angle formed by the two straight parts is attained, or until the glass from cooling has become too hard to yield; in the latter case it must be re-heated, and the operation completed.

The heat should be nearly uniform all round the glass, that on applying force, all the parts may give way together, the glass at the convex surface being extended to a certain degree, and drawn out, whilst that at the concave surface is equally but uniformly thickened by its necessary contraction into a smaller space. If the glass be much hotter, and consequently much softer, on one side than the other, weakness or distortion of the bend usually happens. For if the hot part be on the convex side, it yields during the operation much more than the stiffer glass on the cooler part, which consequently undergoes but little contraction, whilst on the contrary the soft glass is extended considerably, rendered very thin, and usually assumes a flattened form. Or if the hotter part be on the concave side of the bend, the cooler and convex part will scarcely extend during the operation, the hot glass beneath giving way to the force, and becoming generally thrust up into a sharp fold or into wrinkles. Or if the hotter surface be on one side of the bend, then the glass, yielding more easily on one side than the other, usually acquires an irregular and disturbed form. On the whole, it is better that the heat should be somewhat greater on the convex than on the concave part, inasmuch as, though it yields rather more than it ought, it is not so readily formed into wrinkles, and also because it cools more rapidly than the concave side. This more rapid degree of refrigeration depends upon the fact that the glass on the convex side becoming extended and thinner, consequently loses heat faster than the concave part, which, owing to contraction during the operation, becomes thicker; this circumstance may therefore be compensated by a little extra heat at the first.

23. If the glass be too hot, it gives way so readily during the operation as to assume irregular forms, and sometimes, especially in sharp bends, becomes flattened; the convex and concave sides approaching each other, and the lateral portions extending outwards. This particular condition is even useful occasionally, as it prevents the necessity of great extension or contraction of the glass on the convex or concave surfaces; but an irregular and wrinkled bend should never purposely be allowed, the bore of the tube being preserved nearly as round and free there, as elsewhere. If a part be observed on bending to lose its proper form, and to become flattened or wrinkled into folds, from the heat being either too great or irregular, that part should be allowed to cool a little whilst the heat is applied to the neighbouring portions, particularly to such as by contraction on the concave, or expansion on the convex sides, during the continuance of the operation, are likely to rectify the irregularity of form just commencing.

Thin and small tube will require much less heat and generally more care, than that which is thick or large; but it is the degree of softness which, indicated by the feeling, must principally guide the operator in his proceedings.

24. When a considerable bend is to be made, the angle formed by the two arms being very small, as in a syphon for instance, it should not be effected entirely at one particular part of the glass, but a portion having been heated and bent as far as possible, without weaken-

ing or distorting the tube or contracting the bore, the neighbouring parts should be heated and the curvature continued until the desired inclination of the two arms is obtained. Small and thick tube may be bent more sharply than large or thin tube, the latter requiring greater extent of curvature for the preservation of the proper form.

25. When, during the operation of bending, different parts are to be heated and bent in succession, it is best to begin the operation at one end of that part, over which it is to extend, and gradually proceed from it to the other end. By thus proceeding, the operator may contrive, when one part is heated and ready to be curved, to remove it sideways from the flame, so as to bring the next portion into the heat, which will then be acquiring temperature, whilst the former part is bending, and in consequence of its previous high temperature resulting from mere vicinity, will soon be in a properly heated state. This transition, as it were, of the tube through the flame, must not take place irregularly, but gradually, the heating and bending going on without interruption, and over successive portions of the tube, at the same time. A clear idea of the manner in which this is to be done, and very useful first practice, may be easily acquired by using a spirit-lamp flame without a blow-pipe, and drawing a piece of quill tube through it so gradually, that the part in the flame shall be heated red hot before leaving it. It will then be found that by giving lateral pressure on one end of the tube the parts will be bent and curved in succession as they become heated, and fixed as by their motion onwards they become cooled.

26. When the flexure is required so near the end of a piece of tube as to render it impossible to hold the shorter side with the fingers, the force required must be given by pressing against the end with a piece of wood or another piece of glass tube. But if the bend is to be continued to the very extremity, then wood or glass will not answer the purpose, for the first would burn and soil the tube, and the last, melt and adhere to the heated part. In such cases cold metal, as a metallic rod, is the best adapted for use, but it should be applied only at the moment when pressure is wanted, and never be retained so long in contact with the hot glass as to reduce its temperature below the point of softness; for as soon as the glass becomes solid, the cold metal would crack it. For the same reason, metal should not be used in the cases where wood and glass have just been recommended, as it would probably crack the hot, but solid, part of the glass. Whenever cold metal is brought into contact with glass for the purpose of moulding or working it, the glass should be hot and not be allowed to cool to its point of hardness. The metal itself should always be cold in such cases, or at least not very hot, otherwise it will adhere to the glass and cause injury; neither should it be small, like a wire, lest the glass itself should communicate so much heat as to cause its adhesion. If the metal be hot, and the glass below its soft point, they may be brought together without risk of fracture to the glass.

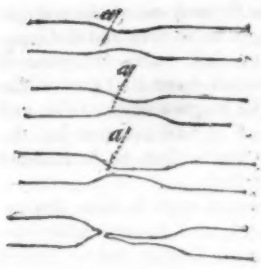
27. Quill tube, as has been already remarked, may be bent in the flame of a spirit-lamp. It may also be bent over the glass of an ar-

gand lamp in good combustion. Larger tubes may be curved over a charcoal fire, either in the crucible furnace, or arranged on a piece of metal plate. Their flexures are large and gradual, not so short and sharp as those effected by the lamp and blow-pipe. Cooper's lamp furnace is a very excellent instrument for softening considerable lengths of tubes when the bend required is to be very gradual and extensive. The tube should be continually moved in the flame, both with a lateral and rotatory motion, until uniformly heated to a sufficient degree.

28. The next operation to be described is equally useful with the last: it is that of closing the extremities of tubes so as to shut up one end and form those useful vessels already often referred to. This operation is most readily performed with a piece of straight tube, open at both ends, and long enough to make two closed tubes. Let it be therefore supposed that a piece of tube, such as that before mentioned (21.) is now to be formed into two tubes, each closed at one extremity.

29. The piece of tube is first to be heated in the middle; but in place of endeavouring to extend the heated part as far as possible, it should rather be contracted into a narrow ring (10.) The hands are then to be separated, the glass being pulled in the direction of its length, when it will be found to elongate, and at the same time contract in diameter at the hot and soft part. Some degree of management in the heat is now required. If it were still to be urged upon the middle of the contraction, and the pulling force also continued, the tube would suddenly be divided into two parts with irregular, long and pointed terminations. For as the glass is drawn out, and the diameter as well as thickness diminished, the flame acts upon it as if it were a smaller tube: the smallest part is consequently always hottest, it yields most readily to the force applied, and thus the hasty and imperfect result mentioned would be obtained. If, on the contrary, to avoid this, the glass were moved so that the flame fell upon and heated the portions at the side, then their softness might be made to surpass that of the contracted part of the tube, and the pulling would merely tend to elongate and contract this part also, and so to reduce, as it were, the whole of the tube to portions of tube of greater length but smaller diameter.

30. It is an effect between these that the operator should produce. As soon as the glass yields to the pull, and in proportion as the diameter diminishes, he should relax the force so as to apportion it to the softness of the glass, and proceed gradually with the operation: he should at the same time move the glass towards the extremity of the flame, and even out of it, that he may be able to moderate the heat and apply it principally to a small surface. He should no longer endeavour to keep the two pieces of glass of equal form, but using one as an adjunct, turn all his attention to finishing the extremity of the other, which probably will be that in his left hand, because the piece in his right hand becomes the tool with which he works, and which is most adroitly used by it. Directing, therefore, the point of the flame upon what is to be the bottom of the closed tube, a little above the



thinnest part, but still not so much above as to render the thicker part the softest, let him carefully retract his right hand, by which operation the narrow part will become more and more attenuated, and finally, when capillary, fuse and separate. The end of the tube will be left closed of a round form, with probably a little knob of glass at the middle of the bottom, whilst the other piece will be drawn out rather irregularly, though closed also at its extremity. The accompanying wood-cut illustrates the successive changes in the form and appearance of the tube; the part to which the greatest heat should be applied, being pointed out by the lines *a a a*.

31. The tube is seldom perfectly finished by this operation. To complete it, the knob of glass at the end, if small, and the whole of the bottom of the tube, should be heated until the glass is soft. Then applying the open end of the tube to the mouth, and propelling air into it with a degree of force proportionate to the heat of the glass, it will yield, the knob expanding more than any other part, because of its greater temperature, and of its continuing for a greater length of time in a soft state. In this manner, by a little address, the knob may be made to disappear, and the bottom of the tube to assume a regular, round form, and a thickness nearly equal in every part.

32. If the knob be so large and clumsy in consequence of the partial failure of the first operation, that if heated so as to run up and make part of the bottom of the tube, it would cause the formation of a very thick portion of glass there, then it must be removed. For this purpose it is to be heated, and a piece of waste glass previously warmed in another part of the flame while held in the right hand, applied to it: then directing the point of the flame above the junction and against the part intended for the bottom of the tube, the glass should be melted, the thick clumsy knob drawn off, and a fresh closing of the tube effected and finished as before. Or if, from want of practice, the end of the tube be irregular, misshapen, and altogether bad, then after attaching the piece of waste tube, which serves as a tool, the heat is to be applied a little way up the tube, the glass softened in another place as near to the first as possible, and the operation recommenced; the piece of glass at the end being drawn off and managed by means of the fragment of tube which had been attached to it for the occasion.

33. If the end of the tube when finished be thin, it should be raised to a red heat, with a little of the neighbouring thicker part, when it will gradually contract and thicken, and it may thus be made of equal strength with the sides of the tube. Its thickness must be judged of by inspection, in the manner formerly described. On the contrary, if it be too thick, it may be rendered thinner by being blown out as mentioned above (31.) The precautions requisite in doing so will be immediately described (52, 56.)

34. Having finished one of the tubes to be formed out of the original piece, the other, which had been laid down, is to be resumed and completed. For this purpose, when held in the left hand, the point of the flame is to be directed as before mentioned upon that part of the contracted termination, which is to form the bottom of the tube, and when soft the tail of glass is to be drawn off in the manner just described for removing a knob (31.) The tube is then to be finished according to the directions already given (31.)

35. When the piece of tube to be operated with is thin, the extent of surface heated at first must be greater, and the operation carried on more carefully, than is necessary with thicker tube. For if a small extent only be heated, and then drawn out quickly, the glass becomes so attenuated, that when very hot it will of itself run into holes, or if it remain undivided, will form a bottom to the tube, so thin that it will not be safe to trust such a vessel for an experiment, lest a slight accident should break it. In this case, after the tube is partly drawn out and its diameter contracted, the heat should be raised considerably but uniformly round the thin narrow part, and the glass being retained in an undisturbed state, should be allowed to draw together and thicken. When that has taken place to a sufficient degree, it is again to be drawn out, and if a second time it become too thin, it must be thickened as before: in this manner the operation must proceed, until the bottom is closed and completed.

36. When a piece of tube is too short to be formed into two tubes, it must be sealed at one extremity: an operation often required for other purposes. In these cases, the end to be sealed must be heated carefully (6,) the tube being inclined a little with the heated aperture towards the direction of the course of the flame, that the force of the blast may not throw hot air into and along it, and burn the hand at the other extremity; and also that the products of the combustion may in other cases be prevented from entering the tube and affecting the substances already placed within it. When the end is soft, a piece of waste glass tube is to be held in the right hand, and its extremity used to press the sides of the hot end together, and when three or four places on the edge have been made thus to approach each other, the end of the spare tube is to be attached to them, and the heat being raised a little above its termination, the piece is to be drawn off, and the operation proceeded with exactly in the manner already described (30, 32.)

On the preparation of the Silver Gilt Wire, used in the Manufacture of Gold Lace, and for other purposes. Extracted from Dr. WILLIAM LEWIS'S *Commercium Philosophico-Technicum.*

(Concluded from p. 90.)

THE rolls, as well as the drawing-plates, have been often procured from France: and it has been thought that the wire received from

the French rolls an additional beauty and lustre; though it does not appear that the French have any durable advantage in this respect above the English, or that the glossiness communicated by either is of any real advantage to the manufacture, for it quickly goes off. The most important point, in their preparation, is, the giving them that perfect truth and equality of surface, which the flatting of so fine wire demands. The internal part is formed of iron; and a plate of refined steel is lapped round, and welded over the iron. Where the two ends of the steel plate meet, there is frequently an imperfection, the juncture being generally visible across the surface of the roll. In rolls of great width, some curious artists have obviated the inconveniences arising from this cause, by using, instead of a broad plate, a long narrow bar of the steel, and twisting it round the roll in several circumvolutions; that the little inequalities, in hardness and solidity, happening at the junctures, might be in the direction of the riband that passes between the rolls, and not transverse to it. In the narrow rolls, used for the flatting of wire, a practice of this kind would be very difficult; but the same end might, perhaps, be answered, and even more effectually, by casting the steel, instead of a straight bar, into the form of a hoop or ring, of a somewhat less diameter than the size of the intended roll; then forging the hoop, on the round beak and flat of the anvil, alternately, to procure it the requisite uniformity of its parts, and the due extension; afterwards placing it in a proper mould, fixing the axis in its due position, and running into the intermediate space some cast-iron, which, from its known property of expanding, as it sets or becomes solid, will continue every where to fill the cavity, and irremoveably fix itself, both to the hoop and to the axis.

The degree of extension of Gold, in Wire and Leaf.—The vast extent to which gold is apparently stretched, in the foregoing operations, has induced several persons to make experiments, for determining its exact degree, by mensuration and weight. In an experiment of Reaumur's, forty-two square inches and three-tenths of gold-leaf weighed one grain troy; and Mr. Boyle found that fifty and seven-tenths weighed but a grain. As a cubic inch of fine gold weighs 4902 grains, the thickness of the gold leaf, examined by the one, was the 207,355th; and of that by the other, only the 248,532nd part of an inch.

Dr. Halley found, that, of superfine gilt wire, six feet weighed a grain. M. de Reaumur makes about four inches more go to the same weight; and Mr. Boyle is said, if there be no error in the numbers, to have had gilt wire much finer than any of these. Allowing six feet to make a grain, and the proportion of gold to be that commonly used by our wire-drawers, the length to which a grain of gold is extended on the wire comes to be near 352 feet.

In flatting, the wire is extended, according to M. de Reaumur, one-seventh part of its length, and to the width of one ninety-sixth of an inch: in some trials I have seen made by the workmen, the extension in length appeared less, but that in breadth so much greater, that the square extension was at least equal to that assigned by

Reaumur. Hence, one grain of gold is stretched on the flatted wire, to the length of above 401 feet; to a surface of above 100 square inches; and to the thinness of the 492,090th part of an inch.

M. de Reaumur carries the extension of gold to a much greater degree. He says the wire continues gilded, when only one part of gold is used to 360 of silver; and that it may be stretched, in flatting, one-fourth of its length, and to the width of one forty-eighth of an inch. In this case, a grain of gold must be extended to 2900 feet, or upwards of half a mile; and covers an area of more than 1400 square inches. He computes the thickness of the golden coat, in the thinnest parts of some gilt wire, to be no more than the fourteen-millionth part of an inch; so that it is only about a hundredth part of the thickness of gold leaf. Yet, notwithstanding this amazing tenuity, if a piece of the gilt wire be immersed in warm aqua-fortis (nitric acid,) which will gradually dissolve and eat out the silver, the remaining golden coat will still hang together, and form, while the fluid prevents it from collapsing, a continuous opaque tube. To succeed in this experiment, the aqua-fortis must not be very strong, nor the heat great; for then the acid, acting hastily and impetuously upon the silver, would disunite the particles of the gold.

Whether any other metal can be extended to an equal degree, is not yet as clear; for, as it is the great value of gold which engages the workmen to endeavour as much as possible to stretch it to the largest surface, the same efforts have not been made in regard to the less valuable metals: to make a fair comparison, trial should be made of extending silver upon the surface of gold, in the same manner as gold is extended upon silver. It may be observed, also, that, as gold is nearly as heavy again as silver, or contains nearly double the quantity of matter under an equal volume; so, if equal weights of the two metals be stretched to equal extents, the silver will be little more than half the thinness of the gold; and conversely, if silver could be brought to equal tenuity with gold, in regard to bulk, it would, in regard to quantity of matter, be nearly of double extensibility.

Application of gilt wire on other bodies.—There are various methods of applying the gold, thus extended, to cover the surfaces of other bodies. For laces and brocades, the flatted gilt wire is spun on threads of yellow silk, approaching, as nearly as may be, to the colour of gold itself. The wire, winding off from a bobbin, twists about the thread, as it spins round; and, by means of curious machinery, too complex to be described here, a number of threads are thus twisted at once, by the turning of one wheel. The principal art consists in so regulating the motion, that the several circumvolutions of the flatted wire on each thread may just touch one another; and form, as it were, one continued covering.

It is said, that, at Milan, there is made a sort of flatted wire, gilt only on one side, which is wound upon the thread, so that only the gilt side appears; and that the preparation of this wire is kept a secret, and has been attempted in other places with little success. There is also a gilt copper wire, made in the same manner as the

gilt silver. Savary observes, that this kind of wire, called false gold, is prepared chiefly at Nuremberg; and that the ordinances of France require it to be spun, for its distinction from the gilt silver, on flaxen or hempen threads. One of our writers takes notice, that the Chinese, instead of flatted gilt wire, use slips of gilt paper, which they both interweave in their stuffs, and twist upon silk threads: this practice he, inconsiderately, proposes as a hint to the British weaver. Whatever be the pretended beauty of the stuffs of this kind of manufacture, it is obvious that they must want durability: the Chinese themselves, according to Du Halde's account, sensible of this imperfection, scarcely use them any otherwise than in tapestries, and such other ornaments as are not intended to be much worn, or exposed to moisture.

Purification of gold, from platina, silver, and base metals.

Aquaregia (nitro-muriatic acid,) in dissolving gold, leaves behind what silver the gold had been mixed with; and certain bodies, added to the solution, separate the gold from it, without being able to separate any metal besides; so that, on this principle, gold may be brought with ease, to its ultimate purity.

The gold, flatted into thin plates, or reduced into grains, is to be put into about thrice its weight of moderately strong aqua-fortis (nitric acid,) and the vessel being set in a gentle heat, a little sea-salt (muriate of soda) is to be added: the dissolution will immediately begin, with a considerable effervescence; and when the action ceases, a little more sea-salt will renew it: the injection of sea-salt is to be continued, by a little at a time, till the whole of the gold appears to be dissolved: the quantity of salt requisite is generally about a third of the aqua-fortis. The clear part of the solution is to be poured off, and the remainder passed through a double filter of paper: the undissolved matter is to be washed two or three times with water in the filter, and this liquor poured to the rest.

For recovering the gold from the solution, Cramer directs two methods;—distilling off the menstruum, and precipitating the gold by mercury. But, in either of these ways, we cannot be certain of having the gold pure: for, though it has been previously cupelled with lead; yet, if it contained any platina, it will retain the whole of the platina after cupellation; and, in some circumstances, it will retain also a little copper: both the platina and copper will dissolve with it in aqua-regia (nitro-muriatic acid;) mercury will precipitate the platina along with the gold; and the abstraction of the menstruum will leave with it both the platina and copper.

The purity of the gold is secured by precipitation with common green vitriol (sulphate of iron.)

The vitriol is to be dissolved in cold water; the solution passed through a filter, and added, in large quantity, to the solution of gold: the quantity of vitriol before its dissolution, should be ten or twelve

times greater than that of the gold. As the precipitate falls slowly, the mixture is to be set by for twenty-four hours, or more: the liquor, then becoming clear, though of a deep colour, is to be poured off; the brownish powder at the bottom, boiled in a little aqua-fortis; then washed with water, and melted, with the addition of a little nitre.

Gold, thus purified, appears to be perfectly fine; a point not obtainable by any other known means that can be practised in the way of business. Nor does the process seem to be so expensive as the imperfect one, by aqua-fortis (or *parting:*) for there, three parts, or more, of silver, being added to one of gold, at least six parts of aqua-fortis are required for dissolving the silver; whereas the gold, in the above process, may be dissolved by half that quantity of the menstruum: great part of the acid may likewise be recovered, by distillation, from the liquor which remains after the gold has fallen.

Kunckel is the first who has taken notice of this precipitation by vitriol: but, having used a vitriol which partook of copper as well as iron, he seems to have thought that the effect depended on the copper; and recommends the bluest and most coppery of the common sorts of vitriol, as the best: accordingly, most of those who have mentioned this process, direct blue vitriol (sulphate of copper,) or vitriol of copper. I have not found that blue vitriol produces the least precipitation in a solution of gold; so that, by this misapprehension, in regard to the nature of the precipitant, Kunckel's discovery was rendered useless, till Brandt happily observed that *green* vitriol produces the effect which had been ascribed to the *blue*.

On the Structure and Habits of the Seal. *By* John Harwood, M. D., F. L. S.

The seal has not attracted that general and popular notice with which its habits and peculiarities deserve to be viewed; throughout the whole extent of animal life, we discern no more beautiful and obvious adaption in structure to those peculiarities and habits than are presented to us in the anatomy of this creature; indeed, these striking appropriations are so numerous, that it becomes difficult to make choice of those most worthy of attention. Externally, the seal is of an elongated form, its neck powerfully muscular and long, and its body formed like that of a fish, broadest across the chest, and gradually tapering to its hinder extremities. For the convenience of swimming, its fore limbs are so short, as to appear destitute of some of the bones and parts found in those of land-quadrupeds: for we only see externally the feet, having their toes provided with sharp claws; but they are so enveloped in broad membranes as not to be readily traced, though capable of free motion. Such a capability, however, only applies to our northern seals, and a few other species; for the eared kinds of the South Seas have their toes almost immoveable, and furnished with flat nails on the fore feet. After

the gradual tapering of the body, which terminates in a short flattened tail, the hinder feet are observed to be furnished with still broader membranes, which in many South Sea species are even extended beyond the ends of the claws, whereby the extent of surface is greatly increased; but in all, aided by the powerful muscles of the spine, these feet act with immense force on the surrounding fluid, and produce an extremely rapid progression. From such external characters, a beautiful connexion is at once observed between the seal and those aquatic animals which surround it, its feet, for example, being intermediate in their structure between the simply webbed ones of the otter and beaver, and the flattened fin-like ones of the manati, the whales, and other cetaceous mammalia which are more exclusively adapted to a watery element. But, in the skeleton of the seal, these gradations and adaptations are still more apparent: though composed of the usual number of bones, the length and flexibility of its neck is of the highest importance in its economy; for, by the slightest inclination of the head, at the end of this long lever, in any direction, while diving, its centre of gravity becomes instantly changed at its will; and thus are its submarine chases, even after the swift salmon, rendered so marvellously successful, that its only mode of escape consists in darting into the shallows. In the general form of the skeleton, seals bear no very distant relation to the weasels, the chest having an unusual extent of motion, by the free articulation of its vertebræ, and, as in those animals, the liver and lungs are each divided into several distinct lobes, that they may glide smoothly over each other, and not oppose the great curvature to which their bodies are liable. On the same principle, their ribs are placed farther asunder than in most others; while the lumbar regions and pelvis, as in all diving animals, are long and narrow, for the attachment of powerful muscles. We now see that the limbs, although so curiously shortened for aquatic operations, possess the same number and arrangement of bones as those of animals whose actions are terrestrial, subject, however, to interesting modifications; for instance, in the fore-feet, the thumb or inner toe is the strongest, and the outer the weakest; but in the hinder feet, to increase the force and extent of membranous surface opposed to the water, the two outer toes are far the longest and strongest.

From such an aquatic conformation, then, it is sufficiently obvious that the movements of the seal on the land are necessarily slow and imperfect: they have been, not unaptly, compared to those of a caterpillar, being chiefly effected by vertical flexures of the spine. Nevertheless, even under these disadvantages, seals defend themselves and their young with their teeth, with great courage and address; thus I recollect having seen a seaman who had been most severely wounded from too daringly attacking a large seal. It was observed by Aristotle, that most animals have their fore teeth sharp, and their inward teeth broad; but that the seal has them all pointed: now, in fact, in the different species of seal, the skull not only affords much variety in its form, but their teeth differ so greatly from each other, that nothing would be more easy, were it by any means de-

sirable, than to substitute new generic names for almost every known species. These differences are well exemplified in various specimens, in which it may be observed, that their front teeth vary in number, having either four or six above, and four below, while their molares vary from sixteen to twenty-four, all of which, in common with their canine teeth, have more or less pointed surfaces.

In the northern seals, the front teeth above have single points; but in the antarctic species, the four middle, upper, and, indeed, lower, front teeth have a double edge, the two outer ones having single points: their molares are either simply conical, like those of the common seal, or are each armed with three points as in the Phoca Grœnlandica.

As sub-aquatic pursuits are those destined for the seal, and as these were liable to be often accompanied with labour and difficulty, it is obvious that they could not be carried on by animals internally organized like those of the land; for the necessity for so frequently rising to the surface to breathe, would have been an effectual impediment to their success. The Creator has, therefore, so modified the mode of circulation in the seal, that this inconvenience has been counteracted, and yet this has not been effected as in the reptiles; for in them the vessels of the heart are so constructed, that the blood can flow freely through them, without going to the lungs, and thereby occasioning a necessity for breathing; nor (which would produce the same effect) do the auricles of the seal communicate, as was formerly thought. On the contrary, in the seal the original type in the construction of the heart is still retained, as also in the walrus and otter, and other aquatic mammalia, with this exception,—that the veins which return the blood to the heart are so much enlarged, that they are capable of changing their office, and becoming reservoirs for receiving and retaining the blood in its progress to the heart. Thus is the right side of the latter, and the lungs, prevented from being oppressed by its superabundance when the creature is under water, and incapable of breathing, and thus is its life sustained. The largest of these venous reservoirs exists in the liver of the seal; but its whole venous system, like that of the walrus and the whales, is very greatly developed. If I may be allowed the expression, like most other aquatic mammalia, the seal appears to be literally gorged with blood; its blood is moreover of an unusually dark colour, being almost black, which property it perhaps acquires by its constant liability to become arrested in its course; and hence, perhaps, the necessity for so much blood in its circulating system—yet the animal heat of the seal is very great.

We shall next briefly advert to some of the *senses* of this animal. Its very large and dark eyes being directed more forwards than in any other aquatic quadruped, added to the round and human appearance of its head, when raised above the surface of the water, doubtless caused it to contribute greatly towards the formation of those ideal marine monsters of which the ancients have favoured us with so many accounts. The eye of the seal is provided with a most perfect membrana nictitans, or winking membrane, the use of which

it is rather difficult to conceive in aquatic animals, except to shield their delicate organs from the too powerful effects of the light, in rapidly rising from the depths to the surface. The pupil of the seal is vertical, like that of the cat; but its soft expressive physiognomy, which more nearly resembles that of the dog than any other quadruped, and is equally expressive of superior intelligence, is not affected by the cat-like form of the pupil, in consequence of the dark colour of the iris. But the greatest peculiarity in the construction of its eye, is a narrow zone, or two zones, as in the Phoca monachus of the Grecian Islands, encircling the globe, of a thinner texture, so much so as to be only one-fourth part of the usual thickness, and more flexible than the rest of the sclerotic coat; and as the straight and oblique muscles of the globe are inserted anteriorly to these flexible zones into a thicker part of the tunic, it is probable that their simultaneous contraction may alter the length of the axis of the eye, and the form of the transparent cornea, by approaching the latter to the retina, and by rendering it more or less convex, and thus better adapt it to the different media in which the creature lives. I think this the more likely, because I have often observed that seals, on first appearing on the surface of the water, appear somewhat bewildered, and do not distinctly discern objects, till their eyes have had time to adapt themselves to the more rare medium to which they are exposed.

The nose of the seal is an organ of more perfect formation than that of any other quadruped. The nostrils are most accurately closed at the entrance by very perfect valves, to prevent the ingress of water when it dives, and, indeed, at all other times, except when it respires. Its breathing also, at all times, occurs at very irregular intervals, often extending to half a minute between each inspiration, but the quantity of air it then receives is very great. As to the internal formation of the nose, it possesses one of the most beautiful structures which the whole class exhibits, especially from the amazing number of the convolutions of those bones on which the infinite ramifications of the olfactory nerves are spread. It has, indeed, been computed by Sir Busic Harwood, that the smelling surface in the nose of a single seal amounts to the enormous extent of two hundred and forty square inches. Now it is no less worthy of remark that something of this curious complication in the organ of smelling likewise obtains in other aquatic animals, and especially the otter, which is a very remarkable circumstance, when we consider that, as before observed, their nostrils, like their ears, are most accurately closed by valves, to prevent the entrance of the water when they dive, and, indeed, at all other times, except during breathing. A question, therefore, naturally arises,—that if, in the pursuit of their prey, or other sub-aquatic actions, they are at all governed by this greatly-developed faculty, in what way are odorous impressions conveyed to the nose?—an inquiry which has, I think, been by no means satisfactorily explained by those who suppose odorous impressions to be conveyed to the nose posteriorly, from the entrance of the throat.

I really suspect, however visionary it may appear, that seals hunt

their prey, or discover its vicinity, by their sense of smelling, when swimming on the surface of the water; for if dogs are very sensible to the scent of a small aquatic fowl on the surface, as we know is the case, why should not the seal of a distant shoal of fishes, sporting, as they constantly do, on the surface, its proper prey, and by means of organs so far more complicated? The same view of the subject of course equally applies to the delicate nasal organs of the otter and the polar bear. Vision, then, I would say, is the sense which governs the seal in its actions beneath—smelling, when upon the surface, and only when out of the water.

The seals of the northern seas are almost entirely destitute of outward ears. The opening into the organ is, like that of the nose, accurately closed by means of a perfect valve. The internal organ of hearing in the seal presents another beautiful intervening gradation in structure between that of the entirely aquatic and the entirely terrestrial quadrupeds: like the latter, the ossicula are attached to the membrana tympani; and, like the true whales, the inferior circumference of the tympanum consists of bone, of unusual thickness and solidity. As to the faculty, I have reason to believe that seals not only hear acutely, but that they are sensibly gratified by musical sounds. When I was most amongst these animals, they much excited our amusement; for, by uttering a whistling sound, we could readily induce them to follow our boats very great distances, when they would continue to raise their heads above the surface, nearer and nearer, and to fix their large eyes steadfastly upon us.

The tongue of the seal is notched at its extremity, unlike that of most other quadrupeds: it is perfectly smooth, yet is doubtless provided with a tolerably acute sense of taste. The predilection of this animal for the salmon is manifest, from the circumstance of that fish tempting it further within the reach of human persecution than any other; hence, I have often seen seals rise to the surface to breathe with salmon in their mouths, at that period of the year, when they lie in such numbers around the mouths of Irish and Scotch rivers, to cut off the retreat of that fish into the sea, after depositing its eggs in fresh water.

The seal's throat is so provided with a valve at its entrance, that the creature has no difficulty in swallowing its prey when under water, without admitting the latter into the stomach.

Of all aquatic genera of animals, the seal appears to be the most widely distributed over the surface of the globe. The common kind, although generally an inhabitant of temperate seas, not only excites much interest by its annual and well-conducted migrations from shore to shore, but often swims northwards into very frigid regions, though seldom higher than the 78th degree of latitude, where it associates with the Phocæ Grœnlandica, cristata, and barbata.

If we regard the antarctic regions, we find them no less the abode and resort of seals than the arctic, as has been lately signally evinced by the hundreds of thousands which were discovered on that vast tract of desert land south of Cape Horn, which has been called South Shetland, and which commences about the 70th degree of lati-

tude, and from whence they have already almost been extirpated by unceasing persecution. From these seas Lord Anson first brought to Europe the immense Phoca Leonina, the Sea Lion, or Sea Elephant, as it is more frequently called, from its possessing a short trunk, and being a creature of no less than twenty feet in length, and the largest species known. Lord Anson was also, I believe, the first who described the poisonous effects of the liver of the South Sea seals; and I have been informed by a Greenland Captain, that he himself, and one or two others, suffered very severely from partaking of the kidney of the common seal. The Phoca leonina, closing the extremity of its short trunk, greatly inflates it when enraged; so likewise, in the North seas, the Phoca cristata, or bladder-nosed seal, has a kind of hood on the head, which it can inflate with air, and with it protect its eyes and nose when attacked: it measures eight feet in length, and is very ferocious. But the largest seal of our own seas, is the Phoca barbata, the species which I think goes by the name of ground seal among the Greenland fishers, and of whose skin the Greenlanders are said to make their thongs for fishing. A specimen of this seal was shot on the north coast of Scotland, which measured twelve feet in length. There is, I believe, one of these preserved on the top of the staircase at the British Museum.

Among the seals which are provided with external ears, of the South Seas, and which have been associated under a new name, are the Phoca jubata and the Phoca ursina. The former being provided with a mane, and measuring fifteen feet long; while the latter is of much smaller size, and is destitute of a mane.

I have been much surprised at the numbers of common seals, from three to five feet in length, which frequent the western coast of Ireland, having often seen there more than twenty reposing together on a rock. Their numbers appear not only to be owing to the unfrequented nature of that interesting part of Great Britain, but certain superstitions of the fishermen induce them, on all possible occasions, to spare their lives. The common seal also abounds on the north shores of Scotland, and the Hebrides; but, of course, from increasing persecution, rapidly decreases in numbers as we proceed south.

The brain of this animal is, I think, doubtless, of greater proportionate magnitude, than in any other quadruped, and not only does it exhibit in its countenance the appearance of sagacity, but its intelligence is in reality far greater than in most land quadrupeds: hence its domestication is rendered much easier than that of other animals, and it is susceptible of more powerful attachment. These circumstances do not excite more interest among the naturalists of the present day, than they did long ago with Aristotle, Ælian, Pliny, and other ancient observers of nature. It is evidently the common seal, to which Aristotle alludes in his description; and his observation, that it is the only quadruped which searches for its food in the sea, would lead us to suppose that he had not an opportunity of acquainting himself with the walrus and sea-otter.

The large seal, which was exhibited some time ago at Exeter Change, appeared to me to understand the language of its keeper as

perfectly as the most faithful dog. When he entered at one end of its long apartment, it raised its body from the water, in which it was injudiciously too constantly kept, supporting itself erect against the bars of its enclosure, and wheresoever he moved, keeping its large dark eyes steadfastly fixed upon him. When desired to make obeisance to visiters, it quickly threw itself on one side, and struck the opposite one several times in quick succession with its fore foot, producing a loud noise. The young seal, again, which was kept on board the Alexander, in one of the northern expeditions, became so much attached to its new mode of life, that after being thrown into the sea, and it had become tired of swimming at liberty, it regularly returned to the side of the boat, to be retaken on board. Such examples might be greatly multiplied, but these are amply sufficient for our purpose; and I cannot help stating, that aware of this disposition to become familiar, this participation in the good qualities of the dog, it is astonishing that mankind have not chosen this intelligent and finely-organized quadruped, for aquatic services scarcely less important than some of those in which the dog is employed, on the surface of the land.

The seal is among the few polygamous quadrupeds; and, like the rest, the males, during the period of intercourse, enter into violent conflicts. Two young ones are generally produced at a time in the autumn. They are brought forth in caverns, extending from the sea above high-water mark, and here they remain suckling during several weeks, before they venture into the water. When they become fatigued by swimming, we are assured that the parent supports them on her back.

The voice of the seal consists of a kind of bleating, whence doubtless has the common seal obtained the name of the sea-calf, the Phoca vitulina: the voice is, however, liable to great variation, especially during changes in the state of the atmosphere, when they become extremely clamorous. Spending their nights on the surfaces of rocks, or upon the shore, it is during their very sound repose in these situations that they are approached and destroyed with sticks; and when thus alarmed, they tumble their young ones before them into the sea, and are themselves often sacrificed in the very act. But the means by which they are captured in by far the greatest numbers, is by cutting off their retreat to the sea at low water, when, in apparent security, they lie in large herds within caverns: firearms, in these cases, are never had recourse to, as a comparatively slight blow by a stick on the head, or nose, is sufficient to destroy life: this arises either from the thin and fragile nature of the bones of the skull of the seal, or the great and immediate nervous communication which exists between its nose and brain. Among more uncivilized nations, its mode of destruction is far more tedious and less efficient. Thus, for instance, the Esquimaux, after long watching, first strikes a seal with his barbed spear, to which a line is attached, having at its extremity a large floating buoy, composed of the inflated skin of another seal; thus entangled and opposed in all its

efforts to retreat far beneath, as often as it rises to breathe, it receives a fresh wound from the unerring spear of its destroyer.

We now proceed to say a few words on the uses to which this animal is applied, when deprived of life, by the more civilized nations of mankind. As to the benefits which the inhabitants of frigid regions derive from it, they are far too numerous and diversified to be particularized, as they supply them with almost all the conveniences of life. We, on the contrary, so persecute this animal, as to destroy hundreds of thousands annually, for the sake of the pure and transparent oil with which it abounds; 2ndly, for its tanned skin, which is appropriated to various purposes by different modes of preparation; and, 3dly, we pursue it for its close and dense attire. In the common seal, the hair of the adult is of one uniform kind, so thickly arranged and imbued with oil, as to effectually resist the action of the water; while, on the contrary, in the antarctic seals the hair is of two kinds: the longest, like that of the northern seals; the other, a delicate, soft fur, growing between the roots of the former, close to the surface of the skin, and not seen externally; and this beautiful fur constitutes an article of very increasing importance in commerce; but not only does the clothing of the seal vary materially in colour, fineness, and commercial estimation, in the different species, but not less so in reference to the age of the animal. The young of most kinds are usually of a very light colour, or entirely white, and are altogether destitute of true hair, having this substituted by a long and particularly soft fur. [*Quarterly Journal.*

On Retaining Water in Rocks for Summer Use. By Mr. William Smith, *Engineer*, M. Y. P. S.*

As practical applications of knowledge acquired from geology, in relation to the comforts and conveniences of man in a most essential article of life, must be considered matter of importance, I hope to be excused for troubling the Society with a detailed account of what I may call a Geological Reservoir of Water made in the hills near Scarborough, in the driest summer this country has experienced for sixty years.

We know, from the annual variation of springs, that rocks hold a much greater quantity of water in winter than in summer; and we further know, that in wet seasons rocks hold periodically much more than their annual average quantity both in winter and summer: and hence the question as to the possibility of retaining water in rocks for summer use, is decided by the annual and periodical operations of nature.

For the means of altering or improving some of these natural operations, so as to render the irregular supply of water which falls upon the earth more convenient to the general purposes of man, we

* Read to the Yorkshire Philosophical Society March 1827, and communicated by the Rev. W. V. Vernon, Pres. Y. P. S.

must resort to geology;—to find what stratum is fitting for the object, and what site in the range thereof; what the rock lies upon; what stratum or diluvium covers it, and the dip, rises, and troughs or undulations in the strata.

I have for many years entertained notions of the practicability of making use of rocks as subterraneous reservoirs of water, in some cases extensive enough for the use of canals; and once, in a Report on Springs, suggested such a plan to one of our canal companies. But for the use of towns and dwelling-houses, many situations may be found where the joints of a rock are capacious enough for penning up winter water therein, for use in even the driest summers; as many springs which then fail, produce a superabundant quantity in winter.

This was the state of the first springs anciently taken from the adjacent hills, to supply the town of Scarborough; which supply has been from time to time increased and improved at the expense of the Corporation. Within a few years new pipes have been laid at a great expense.

Still, however, in the summer months, when there was much company in the place, water was deficient; and the commissioners for improving the town undertook to search for more water on the hill sides about a mile and a half distant.

In the month of May last a small quantity was found to issue from a bore-hole made several years since for draining the land. On cutting an open channel up to this, the discharge increased, and at the depth of nine or ten feet, amounted to twenty-four hogsheads per hour. This encouraged them to proceed; and the channel, under my direction, was deepened four feet, when the discharge became for some time fifty or sixty hogsheads per hour.

Suspecting from an intermediate and subsequent diminution that we had drawn off a confined stock of water, and that the regular run of the spring at the end of a dry summer might not be found sufficient, I suggested the propriety of damming up the produce of this spring for summer use, as the previous supply was more than sufficient for the town in winter.

The circumstances were favourable for the purpose, as there was no other known issue of water from the rock in that hill, which is about a mile long, narrow on the top, and insulated in all the upper part of its stratification. The same rock is not opened or known any where else on these hill sides, but in a deep valley which separates the insular hill, from the main and higher hill of Falsgrave Moor. In the upper end of that valley a spring was opened several years since in the same kind of rock, and was brought with a declivity of thirty or forty feet round the south end of the insulated hill, near to, and high enough to run into the opening made to the new spring. This was sufficient to prove the general rise of the rock westerly in the base of the insular hill, and beneath an isthmus connected with the main ridge of Falsgrave Moor and Seamer Beacon. The rock in which the spring was found, is a yellowish fine-grained crumbly sandstone, in thick beds, with open irony joints,

the same as in the cliff south of Scarborough Spa. From the quantity of carbonaceous matter in it, it is here called "coaty grit." This sandstone, with its overlying and alternating clays, is analogous in position to the clay and sand and sandstone between the cornbrash and great oolite rocks. At the depth of ten feet the rock was found covered with regular clay about four feet thick; on this a mark of coal, and a thin bed of hard stone full of imperfect vegetable impressions; and up to the surface a very tenacious *slidden* clay. The rock was found, by boring through it, to be ten feet thick, lying on clay. The channel excavated up to the spring about thirty or forty yards long, and fifteen feet, at the upper end, was entirely in a very tenacious clay, partly diluvial, with a few rounded stones in it deeply covered by slidden clay. Within four feet of the edge of the rock, lay gravel (deeply covered also with slidden clay,) consisting of large and small boulders of whinstone, granite, mountain limestone, &c., which gravel, between the clay and the face of the rock, tapered downward "to nothing" in the bottom of the excavation.

About two yards within the edge of the rock (which was nearly as upright as a wall,) a basin six feet in diameter and four feet deep was excavated, to receive the water flowing from the joints of the rock. Cast-iron pipes branching from the main line of pipes were laid up to this basin, to receive the regular flow of the spring, which before the end of summer was reduced to less than six hogsheads per hour. The clay channel, in the bottom of which the pipes were laid, was refilled with clay and puddled, so that no water could pass from the rock but through the pipes. The end of the last pipe was closed, and a vertical aperture made for receiving the run of the spring. No further contrivance was required for stopping the water and damming it up in the rock, than an open vertical pipe, ground to fit tight into the horizontal pipe; and this to the height of four feet was done by pieces of pipe, each a foot in length, tight fitting one into another, for the convenience of wholly or partially damming or drawing off the stored water, as occasion may require; the water being allowed to run in at the top of the pipe.

After the rainy days in the beginning of November last, these short pieces of pipe were put in, one after another, and found to dam up the water in the joints of the rock to the height of four feet, which, from the quantity wasted last summer during the progress of the works, was calculated to contain five thousand hogsheads. The vertical pipe being since closed at top, (and lately also the main iron pipe,) the whole of the water from those parts becomes forced into the cavities of the rock, and now stands fourteen feet deep at the spring, or ten feet higher than we calculated upon penning it; so that the subterraneous reservoir may contain twelve thousand or fifteen thousand hogsheads of water. This will be ascertained in the summer as it is drawn down from time to time into the new arched reservoir in the town. This reservoir, formed of a brick cylinder eighteen feet deep, sunk in the ground, and covered by a dome forty feet span and twenty feet high, surrounded by a strong bank of earth, is calculated to contain four thousand hogsheads. [*Phil. Mag.*

THE ALBANY INSTITUTE.

It is a most cheering prospect to the man of science to witness the frequent establishment of institutions, formed for the investigation of natural history, and the concurrent pursuit of intellectual wealth in the various departments of knowledge. Among the number of such societies recently formed, is the Albany Institute, which has issued the first number of its Transactions. The advertisement informs us that, "The Albany Institute is composed of two Societies, which for various periods of time have existed in this city—*The Society for the Promotion of Useful Arts in the State of New York*, and the *Albany Lyceum of Natural History*. Circumstances, not necessary to be explained, led to a union of effort and property between their members and other citizens, and, as a necessary consequence, to an enlargement of the objects of investigation. The present title of the Association was adopted, under the idea that it would comprise the pursuit, both of science and literature, in their most extensive sense.

"It has been deemed adviseable to commence the publication of some of the papers read before the Society. The members do not flatter themselves that they will greatly add to the general stock of knowledge—they may hope, however, that their efforts will tend to disseminate a taste for it."

To the Editor, the intelligence of the progress of science in this ancient city, has been peculiarly pleasing, as it is associated in his mind with many cherished recollections; his medical studies were pursued there, his first essays as a public lecturer were made there, and were favourably received and liberally supported, and his most intimate and dearest friendships were there contracted. At the period alluded to, there were no public institutions for the pursuit of science; several have been since formed, and he recognises among the names of the officers of the Institute, a number who were formerly known to him, either as veterans, or as youthful volunteers, in the corps of "Lovers of Knowledge."

The following are the contents of the first number of the Transactions.

1. Table of the Variations of the Magnetic Needle, at Boston, Falmouth, and Penobscot, from 1672 to 1800; furnished by the late General Schuyler, to Simeon De Witt, Surveyor General.

2. On the Luminous Appearance of the Ocean. By Lieut. Thomas R. Ingalls.

3. On the Geographical Botany of the United States. By Lewis G. Beck, M. D.

4. On some Modifications of the Electro-Magnetic Apparatus, (with a plate.) By Joseph Henry.

The observations of the second paper, which we extract, are in harmony with the views of another on the same subject, contained in our present number.

On the Luminous Appearance of the Ocean. By Lieut. Thomas R. Ingalls, *U. S. Army. Read before the Albany Institute, March* 26, 1828.

This beautiful phenomenon, which once bore the poetical title of "phosphorescence of the ocean," has more recently, I believe, rested between two solutions: that it is caused by animalculæ, or by the ovula of fishes. A writer in a recent foreign periodical, inclines to the former opinion—viz. that the luminous appearance of the ocean is caused by animalculæ. As I have been for some time inclined to the opposite view of this subject, I am induced to submit an account of some observations made a few years since in the humble pursuit of science.

In the practice of sea bathing at night, in a southern latitude, I had of course noticed and admired the beautiful sparkling of the water when agitated or resisted—but the myriads of bodies of whatsoever sort which emitted these corruscations, were alike invisible and impalpable. On one occasion, however, I struck my arm against a small, soft, mass, which immediately emitted a flash of two or three inches in diameter. But the mass eluded my attempts to secure it, as it was invisible the moment it parted from its accidental contact with my arm. This occurred several times afterwards, and I began to think I perceived a sensation of warmth whenever I struck one of these bodies, though aware how liable I was to be deceived by the almost irresistible association of light and heat, in the mind. A very large one ultimately convinced me I was not deceived; the sensation being, on this occasion, perfectly distinct—grateful—and continuing for a minute or two after the touch.

The masses of marine ovula, left by the tide to heat and hatch on the beach, I had long before observed through the whole process of vivification. First, a transparent mass of jelly—next marked by a white opaque speck, a little distant from the centre—third, this spot fringed with a red border, of the colour of arterial blood, next, a kind of irregular pulsation, accompanied by the development of certain white contractile fibres, and the extension of several large red lines, in radial directions from the focal opaque speck—the appearance of a black speck, ultimately a defined head—and finally, I have seen the rising tide shake out from the mass, the perfect animal, apparently in the full possession of life; certainly exercising the important function of apprehension of danger.

The identity of this ovulum, with the luminous bodies I encountered in the water, appear probable, from their size, consistency, and their abounding in the same regions. It was soon after ascertained: for on a night when the sea was somewhat agitated, I observed the same corruscations in the waves breaking on the beach, and succeeded in obtaining several of the illuminating bodies, by the light of their own flashes. They appeared, as I expected, identical.

When examined by candle-light, to overcome the glare of their

brilliancy, and at the same time to observe their action more clearly, the power of illumination appeared to reside in a similar focal point, to that described as the place of the first phenomena of vivification; and the flashes which could be procured by irritating the mass with the end of a pencil, diverged from this point, in lines similar in magnitude and direction, to the large red ones mentioned in that process. I regret that it did not occur to me, to electrically insulate one of these bodies, and endeavour to obtain shocks; but I was too much occupied with the question above stated, to avail myself of the means in my hands, of making some interesting experiments on the theory of life.

The existence of those large corruscating bodies in the ocean has been before recorded, and there is, I believe, a paper on this subject, by Dr. Mitchill, published ten or twelve years ago; but it is thought some parts of the observations are not on record, and they are now submitted in the hope of being, in some small degree, useful—or pardoned, if superfluous.

The conclusions I formed on this subject, were, that in this instance a luminous appearance in the ocean was produced by marine ovula; and by a rule of philosophizing, all such appearances not proved to proceed from another source, and not inconsistent with this cause, are fairly assignable to the same origin.

Watervliet Arsenal.

On the Combination of a Practical with a Liberal course of Education.
By W. R. Johnson, *Principal of the High School of the Franklin Institute.*

No. III.

The *course of study*, given in the preceding number, is not offered as a *complete* exemplification of *practical* and *liberal* education, united. The combination might, however, be easily extended to the courses pursued at our colleges and universities. No good reason can be assigned why the higher branches of mathematics, logic, ethics, or metaphysics, should not be pursued simultaneously with those sciences and arts, which pertain to the active duties of life.

By referring to the course already delineated, the reader will perceive that it consists of four important classes of studies, each of which has generally been confined to a separate school. The first class includes *English* branches; the second, *classical* studies; the third, *modern languages*, and the fourth, *mathematics* and the *practical sciences.*

Whatever be the destination of the student, whether for active life, or for a literary and professional career; whether he shall finish his studies in this institution, or be removed to a university, the importance of his *English* course will, under every contingency, remain the same. A correct elocution, a degree of facility both in oral and written composition, a knowledge of the great outlines of

ancient and modern history, some acquaintance with the principles of domestic and political economy, and a clear understanding of the provisions of those constitutions of government under which we live: all these, in addition to the more common branches of English education, ought to be acquired by every youth who aims at success and usefulness in his future pursuits.

Those whose views extend to a more enlarged course of study, will, in addition to the *usual* preparation for college, find themselves *actually prepared* for a collegiate education, by having learned the *elements* of most of those branches which they are subsequently to pursue. *Preparation for college* often consists in a meagre, or merely passable, knowledge of Greek and Latin, a little geography, less arithmetic, and scarcely any other attainment. Both precept and example have concurred to inspire a great contempt in the minds of students, while at school, for every other species of knowledge. It is unnecessary to point out the numerous impediments, which a scholar thus slenderly furnished, must encounter in the prosecution of an extended course of liberal education. If the institution to which he is admitted, deserve the name of *college* or *university*, it will immediately demand of him the use of powers and attainments with which he is not provided; and thus the business of his school remains to be prosecuted at the university, which, consequently, is reduced to the rank and condition of a mere grammar-school. This degradation of our higher institutions, in consequence of the defects of our classical schools, has, among other causes, tended to bring the honours, bestowed by the former, into contempt. Men who have received degrees at the *real* universities of Europe, deride the idea of being *re-doctorated* at imaginary ones in America.

Those who understood its nature and influence, have seldom objected to a *classical* course, on any other ground than that of the vast expense of time and money which it involved, and the exclusion of other useful objects, which, on the old system of teaching, it necessarily implied. On the High School system, both these grounds of objection are removed. The expense, to those who study ancient languages, is no greater than to those who limit themselves to English branches; and by fixing a time for every thing, and causing every thing to *be done in its time*, no exclusion of useful objects is required. The scholar who is destined to be a man of business, is enabled to acquire all the classical learning which is necessary to a comprehension of the derivations and construction of his own language. The allusions to ancient customs and manners, which abound through our English literature, will, likewise, be sufficiently obvious to his understanding; and a taste for correct and chastened style in thought and expression, will have been acquired. This amount of influence from classical learning, is desirable for every citizen in an enlightened and civilized community.

The course of *modern languages*, is of equal importance, whether we regard it as a part of a *practical*, or of a *liberal*, education. In all our commercial cities, the man who cannot use the French language, will find his sphere of profitable operations essentially limited;

and the vast number of persons, inhabiting every part of our country, to whom this language is *vernacular*, will furnish innumerable opportunities of profiting by a familiar acquaintance with this universal medium of international communication.

The obvious utility of the Spanish, in facilitating every sort of intercourse with the southern parts of our continent, renders any discussion of its merits unnecessary.

In some parts of our country, the *German* is even more necessary, for success in business, than either of the two languages above mentioned; thousands of our citizens speak no other: of these many who possess a partial knowledge of the English, still, naturally, give a decided preference to their own strong and expressive dialect.

If we regard the study of these several languages merely as part of a liberal education, their value is in no degree diminished. The treasures of literature which they unlock, are as valuable and delightful as those unfolded by any language of antiquity. Nor can we excuse our ignorance of these tongues, by alleging that all the taste and beauty of foreign authors, have, through the medium of translations and imitations, been transfused into our own literature. Every competent judge of the matter, knows the allegation to be unfounded. It is surprising, that, at many of our colleges, these languages are rather tolerated than encouraged. When those institutions shall have completely divested themselves of a monastic character, we may hope to find modern languages among the essential requisites for graduation.

But whatever merit may be claimed for the three divisions of our course already enumerated, the *fourth* is not less important, less practical, or less adapted to the age of the pupils for whom it is intended, than either of the former. The several branches of mathematics, practical mechanics, natural philosophy, elementary chemistry, the philosophy of natural history, with drawing and perspective, all appeal, more or less directly, to the *senses*, and consequently excite the interest of youth more forcibly than subjects in which laws and relations are to be comprehended only by means of abstract and general expressions. Experience justifies this inference respecting their adaptation to the capacities of early youth.

Scarcely one of the numerous branches of industry in which our citizens now engage, can be successfully prosecuted for a single day, without involving the use of some one of these departments of practical science. Hence their utility is unquestionable. And every professor in our colleges, must doubtless have felt that the advantages to his hearers, and the pleasure to himself, would both be greatly enhanced, if the former could bring to his lectures some just and accurate elementary ideas, on the subject about which he was to address them. What has been said above, respecting the inconveniences occasioned to higher institutions by the want of proper acquaintance with English studies, applies with equal force to these sciences. Our colleges are degraded, because their professors are compelled to dwell perpetually upon the elements of their respective subjects.

In arranging this *course*, it was a primary object to produce an

easy and natural transition from one branch to another, in each of the great departments; to introduce nothing as a merely ornamental accomplishment; and to cause the student to behold his interest blended with his duty. It is not predicated upon the maxim which has sometimes been broadly proclaimed,—that one branch of study is as good as another, provided it cost the scholar the same kind and amount of toil, to perform what is required by his teacher. It is founded upon the belief, that with respect to intellectual education, that is the best, which, with the greatest number of theoretical and practical truths, furnishes the highest improvement of the faculties, and affords the most enduring mental pleasures.

No ordinary share of talents and industry must be possessed by the scholar who would, within the time allotted, accomplish all that is contained in the course above described. Still, however, those who are accustomed only to that sort of application, which dreams away time, or pores with excess of disgust over one or two tedious volumes, can scarcely imagine the result of a system which by varying the occupations, multiplies the energies of the mind, and by riveting the attention to its immediate object, makes permanent acquisitions at every step.

The chemist knows, that when water is saturated with one salt, it will still dissolve a large portion of another of a different kind; and when saturated with this also, that a third may be added without *precipitating* either of the former. The youthful mind has similar affinities for *varied* pursuits, and analogous points of saturation. Much of the profitless labour of teachers consists in attempts to super-saturate it, with some *one* ingredient, to the exclusion of others which it would eagerly receive.

An Essay on Calico Printing.

[Extracted from Parke's Chemical Essays.]

As the whole of this ingenious business, as it is now conducted, depends upon the proper application of a few compounds called mordants, it will be necessary, in the first place, to explain their nature and uses. In doing this, one or two preliminary remarks will assist us.

The colouring substances chiefly employed in this art, are divided into two classes, viz. *substantive* and *adjective*. A SUBSTANTIVE colour is one which is capable, of itself, of producing a permanent dye; such is the juice of the buccinum,* used by the ancients for producing the imperial purple; such are also the woad and indigo†

* It has been proposed to employ this valuable permanent colour for pencilling on fine muslins. I believe it might readily be procured in sufficient quantities, and would prove an important addition to the resources of the British calico-printer.

† Dr. Bancroft tells us, that the first mention of indigo, as known in England, is in the Act of the 23d of Queen Elizabeth, chap. 9, where it is called *Ancle*, or *Blue Inde*. Bancroft *On Permanent Colours*, page 138.

employed by the moderns for producing a permanent blue; and we may add the metallic solutions, particularly those of iron, cobalt, gold, platinum, and silver, which give various colours according to the processes by which they are prepared.

By ADJECTIVE colours are meant all those which are incapable of giving permanent dyes without the aid of certain intermedia, which form, as it were, a bond of union between them and the substances intended to be dyed.

These intermedia are what are known by the term MORDANTS, and they are used for this purpose in very considerable quantities by the calico-printer of the present day.

"The ancient Gauls and Britons were not ignorant of the method of imparting various dyes by means of substantive colours; we have even direct evidence that they excelled in some branches of this art, and possessed valuable secrets in it that were unknown to other nations. Several of the herbs which the Gauls and Britons used in dying are occasionally mentioned by Pliny, in different places; but the herb which they chiefly used for this purpose was the *glastum* or *woad*, the isatis of Linnæus; and they seem to have been led to the discovery of its valuable properties in dying cloth, from the former use of it in painting and staining their bodies."*

Several expedients were also employed by the ancients to produce fast, or, more properly, permanent colours, by means of mordants, as appears from the testimony of Aristotle and Pliny. The chief articles in use at present in Great Britain, are the acetate of iron, the acetate of alumina, and the various solutions of tin, all of which should be very carefully and correctly prepared.

When piece-goods are designed to be dyed of one uniform adjective colour, they are first immersed in a solution of one of these mordants, and are then hung up to dry, and to absorb the oxygen of the atmosphere. When sufficiently exposed to the air, they are washed or dunged,† to remove the superfluous mordant; that is to say, that part of it which is not chemically combined with the cloth; and the pieces are then submitted to a bath of that particular kind of colouring matter which is to be imparted to them.

It may here be remarked, that if a sufficient number of colouring substances should ever be discovered, that have no affinity for any thing but the chemical mordants, the business of calico-printing would be rendered much more easy and simple than it is at present.

Whenever it is meant that a colour should be partially inserted, the mordant is applied to those particular parts only; so that, when

* Henry's *History of Great Britain*, 8vo. vol. ii. page 128.—Pliny's *Natural History*, books 16, 18, 21, and 22.

† The dung of the cow is used in such large quantities by the calico-printer, that it has become an article of great expense. The proportion that is employed is usually about one bushel to one hundred gallons of water, though frequently a larger proportion would be more effectual. The brightness of the colours, and the purity of the whites, are always dependant upon the quantity of the dung employed.

the piece is immersed in the colouring bath, no other place will receive the permanent stain. For though the whole surface of the cloth will be coloured, yet having in itself no affinity with the vegetable with which the decoction is impregnated, the whole of the colouring matter will be easily removed by exposure to the air, and the ground of the piece restored to its original whiteness; while those parts to which the mordant was applied, will retain and fix the colours in a way which will be more fully explained hereafter.

Formerly, all calico-printers were bleachers; but in the neighbourhood of London these are separate and distinct trades, and the printer either purchases bleached goods for printing on his own private account, or receives the cloth from his customers in a white state; and, when printed, he returns the identical pieces, and is paid so much per yard, according to the number of colours, for printing them.

Chloride or oxymuriate of lime is the agent generally employed in bleaching; but it appears to me that some other article might be introduced with advantage. For, as the goods are washed in diluted sulphuric acid when they are taken from the oxymuriate of lime, a sulphate of lime is always formed, which becomes fixed in the fabric, and, acting as a mordant when the pieces come into the madder copper, occasions an indelible stain, which in very fine goods, often impairs their beauty. If oxymuriate of soda were employed, the sulphuric acid would form a soluble salt with the soda, easily removable by washing. The expense of this article, will, however, be always an objection to its use, except for rich and valuable prints.

I am aware that some printers, who are more anxious about the quantity, than the quality of the work they perform, would deride this caution, and say they can obviate the difficulty by washing the goods *before* they are submitted to the sulphuric acid. But I am so confident of the extreme difficulty there is, even in this way, of removing the oxymuriate of lime, that I know the inconveniences above mentioned will very often occur, almost inevitably.

In my opinion every printer should bleach his own goods, for it is impossible always to rely with confidence on the care of those who bleach for hire; and every printer knows that good bleaching is absolutely a necessary preliminary in the production of good printing. Indeed, this is now pretty generally acknowledged in the north of England; for most of the opulent houses in Lancashire and in Scotland, who produce fine work, are bleachers as well as printers.

No people have taken more pains to excel in bleaching than the Irish, and their credit is established accordingly. The German linen is, I believe, generally better than theirs; but the Irish has always the preference in foreign markets, owing to the superiority of the Irish in bleaching and finishing.

By whatever means the bleaching is performed, the printer commences his part of the business in the following manner.

The goods are first DRESSED by singing off the whole of the nap

which is attached to them. This is effected by the following contrivance: Ten pieces are generally wired together, and wound upon a roller, from whence they are passed over a hot iron, nearly in the form of half a cylinder, and received upon another roller; from thence they are returned to the iron, which is still kept red, or nearly at a white heat. The use of repeating this process is to remove the nap more effectually than it would be done by passing it only once over.

The next operation is that of STEEPING, which consists merely in soaking the pieces for twenty-four hours in a vessel of weak alkaline lie, at a temperature of about 100°. These operations of singing and steeping are going on at one and the same time, which effectually prevents any accident that might otherwise arise from the effects of the hot iron.

The goods are then boiled or else bowked in a solution of potash; (some workmen prefer to have this alkali in a pure caustic state;) they are then well cleansed, by thorough washing in wash wheels, or in stocks, to ensure their being entirely divested of the alkali. The intention of thus treating them with potash, is to remove any grease or impurity that may be attached to them, which would otherwise endanger the evenness and uniformity of the colours. This process is called ASHING.

By some observant calico-printers it has been imagined, that the rendering the lie caustic is apt to impair the texture of the cloth; and I doubt not but that this has often been the case. Under the eye of the master, however, I am sure it might be employed with advantage and safety. With advantage, because *mild* alkali has but a slight affinity for the grease; whereas *caustic* alkali forms a real soap with any oleaginous matter, and then the compound is readily soluble in water. And though the alkali be made perfectly caustic, if the solution be sufficiently diluted, it may be used with perfect safety.

It may be remarked, that in weaving calicoes the workman generally greases the reeds, in order to make them move easier. Whenever this grease is in the cloth, it becomes fixed by the operation of singing; and if it be not taken out before bleaching, it will not come out afterwards by the usual process of ashing and souring; for, when the pieces are submitted to a blue vat to be dyed of a uniform self-colour, all those greasy places will be found to have taken the dye in a very imperfect manner. Tallow is also employed in dressing the warp, and this has a baneful effect on all goods which are designed for printing.

If, however, the calico-manufacturers themselves would make a point of preparing the oleaginous matter for the weavers, and would furnish them with nothing but pure VEGETABLE OILS, such as those of rape, linseed, &c. I think it very likely that these inconveniences would not occur; because the stain from *vegetable*, is not so indelible as that from *animal* oil.

This defect in the operation of the pale blue dipping is often attended with very serious consequences, so that I know of no subject

which better deserves the patient investigation of the calico-printer. I have seen a large number of pieces of printed calicoes which had all taken a solution of iron so as to form an extremely good black; also the acetate of alumina, which had formed, with the madder, a beautiful red; likewise the citric acid, which produced a perfect resist—and yet when these goods came into the blue vat, certain parts of the pattern intended for blue, still remained quite white, the indigo having had no action whatever on those parts; a circumstance which is sufficient of itself to spoil the goods, and render the whole expense of printing the other colours, totally lost.

To cleanse such goods previously to their being printed, various expedients have been adopted, but I apprehend nothing but a solution of caustic alkali can be depended upon. To prove the effect of any method which may be tried, it is a good way to run the pieces through water, and then to pass them from the water so gradually over a roller, as to give the superintendent an opportunity of examining every inch of the surface; and if any part remains greasy, it will be seen at once, for that part will continue dry, while all the rest of the cloth is wet.

There is another way in which the goodness of bleaching might be proved. Let a few of the suspected pieces be run once or twice through a madder-copper, at the temperature of about 180°. This will inevitably mark any part that may be imperfectly bleached; whereas, if the operation has been properly performed, they will come out so little stained, that an intelligent workman, who has been used to a madder copper, will, at once, be satisfied that they contain no impurity that can form a permanent mordant.

The next process in calico-printing is one with diluted sulphuric acid. A quantity of soft water having been poured into a leaden vessel, oil of vitriol is gradually added to it, in the proportion of about twenty pounds of oil of vitriol to every hundred gallons of water, which by weight is in the proportion of about one to forty.

When this mixture has been well stirred, it is ready for use. Sometimes it is employed in this state, at others it is heated to 90° or upwards of Fahrenheit, according to the nature of the work to be done, and the goods are immersed in it. They are not suffered to lie in this acidulous liquor, but are wound by means of a winch over a wooden cylinder, that every part of the cloth may be successively immersed in the fluid, and every part exposed alternately to the action of the atmosphere.

This operation is generally continued for about twenty minutes, and is designed to remove any iron-moulds or other stains which the cloth may have acquired. It has also the effect of neutralizing any portion of potash that may have been left in contact with the cloth. The process is called SOURING.

After this operation it is necessary to wash the goods thoroughly, that no part of the acid may be left in them, to injure their texture; and this is best effected by means of the wash-wheel. The calicoes are then to be regularly and thoroughly dried, which finishes these preliminary operations, known in the trade by the term PREPARATION;

so that those cloths which have passed through these manipulations are said to have undergone a preparation.

Besides the uses already mentioned, there is another advantage attending these processes, viz. that the cloth which has undergone this preparation will bleach sooner, the colours will be brighter, and the whites more delicate, than they would have been had they not gone through these previous operations.

The next process is that of CALENDERING. Here the goods are passed through a set of rollers, which gives them a gloss, and the appearance of their having been ironed. They are now fit for printing. But for copper-plate printing, or cylinder work, the process of calendering is omitted.

In printing fast colours, the artist usually proceeds in this way: He lays the piece of calico, which has been already smoothed by calendering, upon a strong thick table, which is previously covered with a woollen cloth. He then proceeds to apply one or more mordants, as the case may require, for fixing the intended colours. These mordants are applied by means of wooden blocks, with the patterns formed upon them. These blocks were formerly chosen of holly, or other hard wood, and the cutting them was a separate branch of the business. Of late years, however, a considerable improvement has been made in this department, by the introduction of brass or copper; that is, the pattern, instead of being actually cut in the wood, is now formed by means of slender pieces of one of those metals being firmly fixed to the block, so as to produce the pattern intended. This alteration was occasioned by the perishable nature of wood, on account of which every printer has incurred great and unnecessary expense. The pattern when thus formed with copper, is not only more lasting, but it has also the advantage of giving greater sharpness and beauty to the impression.

When it was customary to use wooden blocks, the patterns were not enchased in the wood, but the wood was cut away in such a manner as to leave the pattern in relief. It will be obvious that this must always be the case in *block*-printing.

When the mordant is ready, it is mixed up either with flour-paste, or with a thick aqueous solution of gum arabic, gum senegal, or gum tragacanth.

Flour is an article of considerable consumption with the printers for making paste. Some houses buy twenty barrels of American flour at once. Should it be musty or sour from keeping, it is of little consequence for their use; but they are careful to buy none but such as has been made with sound wheat, for if unsound, it will be of no value for their purposes. Gum tragacanth is much dearer than the other gums; but notwithstanding this, it must be had for some styles of work, as no other will answer for any of those colours or mordants which are prepared with nitrous acid. A solution of gum senegal would be coagulated in an instant by any of those preparations. Of late years an article called British gum has also been much in use for the same purpose; so much so that the making of it has become a distinct and considerable trade. It is merely

common STARCH calcined till it assumes a cinnamon brown colour, and then pulverized and passed through sieves of various degrees of fineness.

When the colour has been properly mixed with flour paste, or with a solution of either of the gums above mentioned, it is then spread upon a piece of superfine woollen cloth, strained tight upon a hoop.

This is placed within another hoop, covered either with sheep-skin or oil-cloth. These hoops are both so broad as to give to each of them the appearance of a tambarine. That which is covered with the woollen cloth is called a *sieve*, the other a *case*. The sieve within its case is now placed in a small tub of gum-water, and is ready for use.

When the apparatus is thus prepared, the mordant is applied by a brush to the surface of the sieve. This is called TEERING.

It should have been remarked, that when a colourless mordant, like the acetate of alumina, is employed, the workman generally mixes a little of the decoction of Brazil wood, or of any other fugitive dye with it. This is called SIGHTENING; and is for the purpose of making the pattern more obvious to the workman, that he may see its progress, and the efficacy of the materials, as he proceeds in printing.

[TO BE CONTINUED.]

Prognostics of the Weather.

[Abridged from FORSTER'S *Encyclopædia of Natural Phenomena.*]

[CONCLUDED FROM PAGE 107.]

Kites made of paper, such as are usually flown by boys, may be converted into useful prognostics of the wind. When several of them are let up together, the higher ones being successively tied to the backsticks of those below them, they will ascend to a vast height. We have known the upper kite in these cases ascend to above one thousand feet high. When the upper one gets a direction different from the lower one, the wind will frequently be found to get into the quarter indicated by the upper kite. This law respecting winds is more strikingly manifested by means of small air-balloons, whose varying directions, as they ascend, portend the successive changes of wind, which often take place first in the higher regions of the air. See *Balloon*, *Cloud*, *Current*, and *Wind*.

When by the motion of kites we perceive that the wind vibrates or shifts its direction, we may be sure the weather will be squally. There is also a kind of bobbing motion sometimes imparted to kites by the wind in variable weather. The kite seems to nod backward and forward, thereby pulling forward the arm of the person who holds it, by successive jerks.

Lamps, from the manner in which they burn, forbode weather.

Before rain they burn less bright, the flame snaps and crackles, and a sort of fungous excrescence grows from the wicks.

Larks, when they fly high, and remain singing a long while in the air, forbode fine weather.

Magpies, in windy weather, fly often in small flocks of three or four together, uttering a harsh cry.

March Dust and *May Sun*, both of which imply a fine dry spring, are said to be particularly good omens for the husbandman. An adage says, "A peck of March dust is worth a king's ransom." We have confirmed, by many years' experience, the truth of the proverb which commends a dry spring, as leading to the most productive summer.

Marygold.—When this plant has its flower well expanded in the morning, the day will be fine. The small field marygold, *Calendra arvensis*, affords a more certain sign of rain when its flowers are closed in the morning.

Mares' Tails, or cormoid curl-clouds in the sky, forbode wind, and sometimes rain.

Martins fly low before and during rainy weather.—See *Swallows*.

Mice, when they squeak much, and gambol in the house, are said to foretel a change of weather, and often rain.

Missel Thrush.—Before storms the Missel Thrush is observed to sing particularly loud, and to continue to do so till the commencement of the rain: from which circumstance it is, in some places, called the Storm Cock.

Moles often afford us a prognostic of rain, by working and throwing up the earth into molehills more than usual.

Muscæ Volitantes, or the deceptive appearance of flies flitting before the eyes, which many persons are perpetually troubled with, occurs, in general, only before rain. Light specks seen on the sky, or on every object which we may happen to be looking at, are also signs that rain will soon fall. The same thing happens in winter before snow and sleet. This effect seems to be produced by some peculiar irritation in the retina, or other part closely connected with vision, and which has its remote cause in the peculiar electric state of the air before rain: it is most frequent before the cool rain which sets in after warm weather, and which is preceded by a cooler wind, possessing peculiar characteristics; this wind blows up the dust in clouds, sweeping, as it were, along the ground, and is usually recognised, to use the vulgar phrase, as "*blowing up rain.*" A headache sometimes follows all these *muscæ volitantes*, which shows, I think, that the atmospherical cause of them produces them by means of some general irritation of the constitution and stomach.

Moon.—The prognostics from the look of the moon are various, and were known of old. When she looks fiery, or red, like the colour of copper, wind is generally to be suspected; when pale, or confused with ill-defined edges, rain; when very clear and bright, fine weather.

The hornedness of the moon is also said to show a change of weather, when the horns are clearly defined. Instances occur rarely of a

double reflection of the moon, owing to the intervention of thin wane-clouds.

When the moon is near the full, or new, people are more irritable than at other times, and headachs and diseases of various kinds are worse. Insanity at these times has its worst paroxysms, and hence the origin of the term lunacy. The works of Drs. Meade, Sydenham, and Darwin, abound with illustrations of this periodical influence.

A vulgar prejudice has prevailed from time immemorial in Sussex, that a *Saturday's moon* brings blowing and wet weather. By some accident this has proved very true during the last twenty years. To ascribe such a phenomenon to the occurrence of the new moon on the day specially dedicated to Saturn, must, of course, obviously appear superstitious; but there may be natural causes why the conjunction of the sun and moon, happening at some such diurnal periods, may, in the long run, turn out to be connected with rough weather; and these periods once falling on a Saturday, would for a long time continue to do so, hence may have arisen this vulgar notion. Old shepherds, gardeners, hunters, and men of education, have alike testified to the fact. Indeed the whole doctrine of periodic phenomena is very little understood.

Nearness of objects.—The greater apparent nearness of distant objects, and the unusual clearness of the distances, are signs of rain. The same has been observed of the mountains and hills in the West Indies before the occurrence of the autumnal rains and tempests; some of the most violent hurricanes of our colonies have been preceded by an extraordinary appearance of nearness in the distant mountains. In this country, also, showery weather is never considered to be at the end, so long as the distant hills appear unusually near. This fact corresponded with the observation of Sir Isaac Newton, that the stars seem clearer and better adapted for observation in the clear intervals of showers, and before a change from fair weather to rain.

Nimbus, or Rain-cloud.—It may be noticed that clouds of any one of the several modifications, at the same degree of elevation, may increase so much as completely to obscure the sky: two or more different modifications may also do the same thing in different elevations, and the effect of this obscuration may be such as would induce an inattentive observer to expect the speedy fall of rain. It appears, however, from attentive observation, that no cloud pours rain until it has previously undergone a change sufficiently remarkable to constitute it a distinct modification, to which the term *nimbus* has been applied. This change seems to consist in the uniting of particles of water differently electrified, which, having a mutual attraction for each other, closely unite, forming visible drops of water, which, therefore, gravitate and descend in rain. The nature of this process will, perhaps, be better understood if we pay attention to what frequently happens in the rapid production of showers, and closely examine this process for ourselves. The ancient Romans

distinguished *Nimbus*, or the cloud itself, from *Imber*, or the falling shower of water.

Noises and Sounds, when they are heard from farther off than usual, often indicate a change of weather. That sound is heard at a greater distance in calm weather, in the stillness of the evening, and in the direction of the wind, is well known, and is easy of explanation. But, independently of these circumstances, there is something particular in the state of the air before rain, whereby it becomes fitter for the conveyance of sound, than ordinary. A lofty veil of cloud, which occurs before rain, has been supposed by some philosophers to act as a kind of sounding-board, so as to convey the vibrations of sonorous bodies farther than clear air; but this explanation is wholly insufficient. The sound of distant church bells, for example, is greater before rain than at any other time; clocks afar off then appear to strike louder, and, consequently, to be nearer than usual. Other noises too, as sawing, hammering, the whetting of the mower's scythe, or the whirling sound of mills, are all heard farther than usual; as are the crowing of cocks, human voices, and music of all kinds. It is a thing worthy of remark, that distant objects appear also nearer to the sense of sight, as well as to the sense of hearing, before and during showery weather.

Ocean.—There are various prognostics deducible from the appearance of the ocean, of which we shall enumerate a few. When the surface of the sea is rough without any wind blowing at the time, we may be sure of a gale before long; for the wind already blowing in some distant part of the ocean is the cause of the swell imparted to the sea. We have experienced this circumstance in the British Channel, and it has been followed before long by a gale.

Ocular Spectra are also frequently signs of weather. The large spots of light which seem as objects, but are in the eyes, denote the fall of rain, and a cooler air. For various other signs, see *Muscæ Volitantes*.

That the change of weather which produces ocular spectra, does so by means of disturbing the stomach and nervous system, seems probable from this circumstance, that similar spectra arise often from overloaded stomachs and indigestion, and from the excitement of the nervous system in fevers.

The ocular spectra of children, who go to bed with too full stomachs, or with irritable nervous systems, are to be referred to modifications of the real impressions of objects seen in the daytime, such as the passage of uncouth faces by the bed at night. The forms of specks and freckles, which pass in imagination before us with closed eyes at night, and which continually change their shapes, are referrible to the previous impression made on the retina and its auxiliary nervous parts, by accidentally beholding the figured paperings of rooms, or the patterns of printed calicoes, during the day.

Owl.—The various omens which vulgar credulity has attached to the hooting and screaming of this bird deserve particular attention. When an owl hoots or screeches sitting on the top of a house, or by the side of a window, it is said to foretell death. The fact seems

to be this: the owl, as Virgil justly observes, is more noisy at the change of weather; and as it often happens that patients with lingering diseases die at the change of weather, so the owl seems, by a mistaken association of ideas, to forbode the calamity.

Paraselene, or Mock Moons, forbode wind or rain.

Parhelia, or Mock Suns, forbode wind and rain. Peculiar refractions of the sun's light of any sort, indeed, are rather windy signs, particularly when the prevailing colour of the phenomenon is red.

Peacocks, when they squall more than ordinary, prognosticate rain. This prognostic is well known in the country, and does not often fail. When the sky has been perfectly clear at eventide, and when farmers have thought the weather about to be settled, I have often foretold a return of the rain from this sign. The squalling of the peacock by night often foretells a rainy day.

Petrels.—The stormy petrel, *procellaria pelagica*, is found to be a sure token of stormy weather; when these birds gather in numbers under the wake of a ship, the sailors are sure of an impending tempest.

Pigeons.—It is a sign of rain when pigeons return slowly to the dove-houses before the usual time of day.

Pintado.—Before rain, the pintadoes, or guinea-fowls, called come-backs, squall more than usual.

Pimpernel.—When this plant is seen in the morning with its little red flowers widely extended, we may generally expect a fine day; on the contrary, when the petals are closed, rain will soon follow. This is the same plant, apparently, which Lord Bacon calls *wincopipe*, and which has also been styled the *poor man's weather-glass*.

Pipes for smoking tobacco become indicative of the state of the air. When the scent is longer retained than usual, and seems denser and more powerful, it often forbodes rain and wind.

Pluviometer, or Rain-gauge, is an instrument to measure the quantity of rain, of which there are many and various sorts.

Plants usually expand their flowers well and perfectly on fine days, but many sorts close their petals against the coming of rain; hence we may often judge of the weather early in the morning by noticing the flowers. Plants are very apt to flag and droop before rain, particularly in summer, when, after long dry weather, the wind that is to bring up the rain begins to blow. Many good nautical observations may be made on marine plants.

Porpoises, when they sport about ships, and chase one another as if in play, and indeed their being numerous on the surface of the sea at any time, is rather a stormy sign. The same may be said of dolphins and grampuses. That the cause of these motions is some electrical change in the air, seems probable.

Quails are noisy before rain.

Quarries of stone and slate foreshow rain by a moist exudation from the stones. This seems analogous to the dampness on stones, stone-steps, and ornaments both of stone and of metal, before rain and in damp weather.

Rainbows are said to be signs that rain will not long continue, a

thing easily understood, because they can only be seen in a passing shower. A rainbow is, for the same reason, a sign sometimes of wet, because the first that is seen shows that showers, and showery weather, are at hand. Double rainbows are very rainy signs. But, after a rainy day, it shows that set rain is giving place to mere showers.

Raven.—When the raven is observed early in the morning at a great height in the air, soaring round and round, and uttering a hoarse croaking sound, we may be sure the day will be fine, and may conclude the weather is about to clear and become fair. On the contrary, this bird affords us a sign of coming rain by another sort of cry, the difference between these two voices being more easily learnt from nature than described.

Rays of the sun appearing in a cloud forbode rain. This phenomenon is, in fact, caused by the image of the sun being reflected in an intervening cloud, the reflected image radiating in the cloud.

Redbreasts, commonly called Robin Redbreasts, when they come near to the houses, and with more than usual familiarity lodge on our window-frames, and peck against the glass with their bills, indicate severe weather, of which they have a presentiment, which brings them nearer to the habitations of man.

Refractions of Light of any remarkable kind frequently forbode rain, and sometimes storms: at sea the knowledge of this is very useful. Circles round the sun and moon, mock-suns, and other phenomena of this kind, together with the unusual elevation of distant coasts, masts of ships, &c., particularly when the refracted images are inverted, are known to be frequent foreboders of stormy weather. What was the natural cause of that singular phenomenon which gave rise to the story of the flying Dutchman, so well known to mariners?

Rooks gathering together, and returning home from their pastures early, and at unwonted hours, forebodes rain.

Sheep, and other flocks and herds, turn their tails to leeward before and during rough weather, and seem to have a presentiment of its approach. They also foretell rain by their gambols and unusual agitation.

Smells, being condensed, and being longer retained by the air, and perceived farther off than usual, denote the coming of rain. The far propagation of sounds, and also the apparent nearness of distant objects, have the same prognosticative value, and indicate rain. Thus the greater perfections in the functions of these several senses, are alike forerunners of foul weather; a circumstance well worthy of the notice both of physiologists and meteorologists.

Snow.—The indications of this phenomenon are pretty much the same as those of rain, and we must judge of its coming by the state of the thermometer, the time of the year, and the wind then blowing. Many persons are unwell before large falls of snow.

Spiders, when they are seen crawling on the walls more than usual, indicate that rain will probably ensue. This prognostic seldom fails. In summer an unusual quantity of webs of the garden spiders denotes fair weather.

Stars.—Though the obscure and dilated appearance of the stars

denotes rain, because it shows that the atmosphere is thickening, as observed by Virgil: nevertheless, previous to a change to rain, and while the barometer is already sinking, some of the most clear skies are seen: by night, on such occasions, the starry firmament is unusually clear and sparkling, and the milky way seems prodigiously light: this, as Sir Isaac Newton observed, is just before the change: rain clouds soon form, and rain rapidly follows this transparency of the heavens.

Soot, when it takes fire more readily than usual on the back of the chimney, or on the outsides of pots or kettles on the fire, indicates rain. Rain is also said to be foreboded by the falling of soot in small flakes, which had been previously carried into the air from the chimnies. Soot also falls down the chimnies into the grate more readily against rain.

Starlight.—The dimness of starlight forebodes rain, as its greater brilliancy does also at times. The various colours of different stars when near to the horizon, and the alternation of colour observed in some of them, are curious subjects of future speculation.

Smoke frequently indicates the state of the air. When the smoke from chimnies mounts up very straight into the air, it is a sign of fine weather; on the contrary, when it blows down, rain will soon follow. Some chimnies smoke before a change of weather, because the wind often changes first, and gets, perhaps, into an unfavourable quarter.

St. Swithin.—When it begins to rain on St. Swithin's Day, which is the 15th of July, it is said to indicate forty days of wet weather. Now, though the limitation of this sign to a particular day is perhaps carrying the idea of St. Swithin's power a little too far, yet for many years we have noticed, that if a showery time set in about this day, we have usually several weeks of showery and variable weather in the sequel.

Stratus, or Fall-cloud, is a fog or mist, so called from being strewed along the ground, and from its consisting of a particular kind of clouds, which fall at night time to the ground. A stratus in the morning in autumn, often ushers in some of the finest days we enjoy.

Stomach.—This organ, in persons of weak and irritable constitution, is often deranged at the change of the weather, and its digestive powers are more under atmospherical influence than people are commonly aware of. Before storms it is particularly liable to uneasy sensations.

Swallow.—When the swallow flies low, and skims over the surface of the ground or the water, frequently dipping the tips of its wings, or bill, into the latter as it passes over its surface, we may always expect rain. The probable cause of this bird flying low before rain is, that its insect prey, foreknowing the approaching change, get lower in the air, and sport under the shelter of out-houses, by the sides of ponds and lakes, and under the shade of trees. Martins and Sand Martins do the same.

Swans, when they fly against the wind, portend rain.

Thunder in the morning is often followed by wind in the evening;

thunder in the evening by much rain and showers. Thunder is often preceded by hot, and followed by cooler weather.

Tinnitus Aurium, or singing in the ears, often indicates a change of weather. There is also a sensation of this kind, accompanied by temporary deafness, which is caused by a great rise of the barometer. A similar sensation is felt on descending from air-balloons and from high mountains and hills.

Toads, when they come from their holes in an unusual number in the evening, although the ground be still dry, usually foreshow the coming of rain, which will generally fall more or less during the night.

Tobacco and Smoking.—When the smoke from a pipe does not speedily disperse, but scents, strongly, the surrounding air, we may be sure of a good day for hunting. For the same quality of the air which retains the scent of the tobacco, will also cause the scent of the animal to remain.

Toothach, like other pains, is often a forerunner of some change of weather, and particularly that species which depends on inflammation of a diseased socket or gum. In certain kinds of weather, and particularly before rain or showers, decayed teeth and diseased gums are very uneasy, and the pain often ceases when the rain begins to fall. The periods of that sort of toothach which depends on the exposure of the nerve in the cavity of the tooth, seem to exist independently of any particular weather, and occur most frequently during the night, when the patient first gets warm in bed. The progress of this sort of toothach is often as follows:—The pain after awhile becomes continuous instead of being periodical, and by degrees subsides; but the socket then, and ultimately the gum, become diseased, and are thence liable to be affected by the state of the weather above described.

Urchins of the Sea, a sort of fish, when they thrust themselves into the mud, and try to cover their bodies with sand, foreshow a storm.

Vanes, or Weathercocks, are usually very imperfect instruments for ascertaining the direction and force of gentle currents of air.

Violins do not sound so well just before and during damp rainy weather as at other times, which seems to be owing to an effect produced by the air-damp on their strings, as well as on the wood itself. The same applies to many other musical instruments.

Vultures, when they scent carrion at a great distance, indicate that state of the atmosphere which is favourable to the perception of smells, which often forebodes rain.

Water-spouts at sea indicate the concurrence of different currents of air, and generally portend unsettled weather. They are produced at sea by the same apparent causes which on land cause *whirlwinds*.

Water Wagons, according to popular phraseology, are a sort of roundish little compact clouds, which fly along in the lower current of wind, and which seem to replenish and feed the rain-clouds; their previous appearance forebodes rain. They are of the modification of clouds called *cumulus*.

Water Fowls, and particularly those tribes which inhabit the sea-shores, were known of old to afford more useful and numerous prognostics of weather than any other indications which sailors can avail themselves of.

Wasps.—Abundance of wasps are said to denote a good fruit year.

Willow Wrens, a small genus of warblers, called *Ficedulæ* in modern books, are more frequently seen in mild, still, rainy weather, flitting about the willows, pines, and other trees, in quest of insects. These birds become numerous towards the middle of the summer, like the swallows, and other small birds, from the accession of broods of young.

Wind-vanes are described under the words Weathercock and Vane. An anemometer, to measure the strength of the wind, is also a useful instrument; the particular nature, fluctuation, and extent or rage of gales and breezes of wind, ought to be minutely observed with reference to their indicative import.

Weathercocks do not always show the real direction of a very gentle wind. The strange figures of them, usually the productions of capricious fancy, are one cause of their imperfection as vanes to indicate the wind. Griffins, half-moons, foxes, or figures of St. Margaret and the dragon, are not good shapes for weathercocks; they ought to be plain fans, the large surface of one side being counterbalanced against the weight of the other.

Whirlwinds forbode rain very often, and generally some change of weather. See *Water-spouts*.

Wind, as well as rain, may generally be foretold by certain prognostics. The sudden depression of the mercury in the barometer almost certainly foretells wind, and, in summer, is frequently an indication of storms. So certain, indeed, is the fall of the quicksilver a sign of bad weather, that captains of ships would do well to prepare against a gale whenever they observe it. The prognostics of windy weather are the fiery look of the clouds at sunset, mare's tail-clouds, the coloured cirrostratus, the snapping of the flame of candles, and numerous signs from animals, described in their proper place.

Woodcocks appear in autumn earlier, and in greater numbers, previous to severe winters, as do snipes and other winter-birds.

Wood-lice, as well as spiders, creep about on walls, particularly the damp walls of old houses and cellars, before rain.

Worms come forth more abundantly against rain, as do snails, slugs, and almost all our limacious reptiles.

Xeranthemum.—The flowers of this plant afford an example in exception to the general rule, being open all the time of rain as well as fair weather; before rain, however, the plant will sometimes droop.

Yarn, particularly hemp yarn, is a good hygrometer, and foreshows rain by getting shorter, and dry weather by lengthening again; because it is affected by that dampness in the air which so often forebodes rain, and which occasions, in our bodies, a sense of coldness and chilliness which the actual state of the thermometer would not

induce us to expect, and which in reality depends on our perspiration being carried off by the dampness of the surrounding air.

Zodiacal Light is a pyramidal cloud of light apparently emanating vertically from the setting or rising sun at the time of the equinoxes, which has been described by Mairan in his treatise on the Aurora Borealis. It seems to be some peculiar effect of refraction.

Observations on the Large Brown Hornet of New South Wales, with reference to Instinct. By the Rev. JOHN M'GARVIE, A.M. *In a Letter to* JAMES DUNLOP, ESQ. *Paramatta.**

DURING occasional hours of relaxation from more important engagements, I have amused myself of late in studying the habits and history of the large brown and black hornets of this country, which I know you have also done with much success. But as my views on the subject do not entirely coincide with yours, I cannot permit this, perhaps the last opportunity for many months, to escape, without making a few remarks upon it, especially as the excellent microscope I received from you (a present of inestimable value in this country,) will enable me to prosecute the subject with more precision than I have yet been able to accomplish.

There are few subjects that have occasioned more discussion to the naturalist and the moralist, than instinct. The one, desirous of resting his knowledge on a few mechanical principles, is unwilling to admit instinct as a direct, operating agent in animals, and particularly in insects, if any cause can be discovered that will account, even imperfectly, for their operations. The moralist, on the other hand, assigns to instinct every thing that indicates an ultimate design, though it cannot be a question with any man, that the same veneration for the Author of Nature would be excited, were every act of instinct reduced to the commonest laws of matter and motion. For He who implanted instinct, on the common view of the matter, must have implanted also the power of acting in conformity to known laws; and these actions, of course, become infallible proofs, that the laws which these individuals follow in their operation, existed before the individuals themselves; giving thus a proof, if any were wanting, that both were created by the same beneficent hand. Instinct, therefore, we conceive, should always be considered as assisted or modelled by organic structure.

Of all the works of instinct, none have excited more surprise than those exhibited by bees, hornets, and other creatures of the same kind, which form their hexagonal cells with such regularity and skill, that the most expert artizan might in vain attempt to imitate or surpass them. Why is it they have chosen this best of all forms "*stipare roscida mella*," by which every atom of their labour becomes of use? Why do they never deviate from this rule? Why have they

* Read before the Wernerian Natural History Society, 12th January, 1828.

never advanced in improvement since the first of the race completed his primitive cell? This, of itself, in place of leading us to assign the effect to instinct, should lead us to ascribe it to the structure of the race, impelled by some principle beyond the reach of investigation.

Instinct implies a power of action for producing some effect, by mechanical means, without the agency of intelligence. To this view of instinct we are not disposed to object, if men do not stop at proximate causes; for, whilst bodily conformation and structure may serve to attain certain ends, the principle from which these flow may still be denominated Instinct.

The hornets of which we speak, are of several kinds. There is a small black species which forms a quadrangular cell, about a quarter of an inch in the side, and from which a number of young ones, to the amount of ten or twelve, may sometimes be taken, of a dry, hard, brittle structure and glossy aspect, without wings, and the head very indistinctly formed. This nest is often attached to the leaf of a wattle or gum-tree, in which case it is often hid by the leaves. It is firmly attached to the leaf by a thin gluten.

There is another very beautiful small nest, whose inmates we have not ascertained, but the form of which is more regular and surprising than that of the bee itself. It is six-sided, and the edges of the angles are formed into a rounded ridge.

The nest of the large black and brown hornet is extremely curious. It is fastened to the branch of a tree, sometimes a peach-tree, and sometimes to the twigs of a low shrub, close to the ground, and hid by high grass, being attached by a small button-shaped protuberance of dry, tough, gummy matter, which is impervious to rain or moisture, and which is, when taken off, in scales similar to the scales of a fish, but of a very different structure. They work downwards for about an inch, and then commence their cells, attaching the button of each cell to the stalk attached to the tree. They have sagacity enough to know that, as the weight below increases, the stalk and button must also be increased above, which they may be seen augmenting with great perseverance. They then increase the number of the cells, making them nearly equal in length, which is generally one inch and a half or two inches. The surface next the tree, that is, the bottom of the cells (for the open end is always downmost, and they build downwards,) is covered carefully over with a gummy substance of a silky aspect, but dry and brittle. The bottoms of the cells externally are distinct and circular. The button and stalk are of a pyramidal figure, very broad near the base, and contracting as they approach the upper end next the tree.

At the bottom of each cell, and covered with a thin substance, like tissue-paper, is a dark brown substance, composed of particles of wood comminuted, and similar to saw-dust. It certainly is not the young animal, but it may be stored up as food for it in its earliest stages of existence. Each cell is cemented to those next it by a hard glutinous matter, which may be obtained in considerable quantities near the bottom of the cells, as they are all tapering below,

and wide above, and the interstices are filled with this substance, by which they are joined to one another, and to the covering that spreads out from the stalk, by which it is fastened to the tree. The nests themselves are rounded below, and circular horizontally. The cells are not always hexagonal: they are, however, placed in very distinct rows, but they are neither so elegantly formed as the cells of bees, nor do they contain any liquid, nor is any use made of their contents. The cells are about two-fifths of an inch diameter, of different lengths, and the breadth of the whole nest is seldom more than that of the crown of a hat.

The insects connected with one nest are not numerous, sometimes amounting to twelve or twenty, sometimes to a few more. When the cells are formed, they seem to take great pleasure in going over them in succession, pushing their heads into the cells, and adding small portions to them by means of their long tongues, palpi, and forceps. They hatch their young in these; and when the young animal is in the cell, they close the mouth of it with the fine tissue-paper like substance, of which the sides of the cells are composed.

The stings of these insects are extremely painful, causing a fulness and deadness of the place affected, that is almost intolerable. Their sight is sharp and quick. They fly directly to the face. One man was stung, not long ago, in the centre of the eye. They attack the cattle in the field, which are terrified at them, except the pig, which is blessed with a happy insensibility to all their attacks, as he merely shakes his sides and his tail, and continues to eat peaches as before.

This insect has a beautiful appearance in the living state, having a number of yellowish-brown segments, on a black ground, around his body; his legs and wings being of the same colour; a fine yellowish colour presents itself on each shoulder, at the root of the wings, and there is a yellow stripe on the forehead. The rest of the body is a beautiful velvet-black, and the tips of the wings are tinged with a light purple colour. It has six legs, the two first of which it uses with great dexterity as hands. They may be seen frequently rubbing them, and thrusting their foot into their mouth, to besmear it with an unctuous substance, which may enable it to seize a firmer hold of its object.

It is from the structure of the fore-legs, which are admirably adapted for the purpose, that, in my opinion, the hexagonal cells derive their character of regularity. When the sun is hot, you may see the insect traversing round his cell, seizing the edge of it in his mouth, and adding a small piece to the sides. When he has done this, he sets his body close to a side, and clasping the cell firmly in his fore-arms, he continues rubbing it upwards and downwards for a considerable time; and as one cell is always a little higher than the one next it, he proceeds thus from side to side, and gives a six-sided form simply by rubbing and working upon the soft materials with his arms. A very little attention will show, too, that he can give it no other form than this or the circle. For his arms are so constructed,

that if he acts uniformly upon any of these sides or angles, as we have repeatedly seen him do, he must form a hexagonal figure, if the materials are pliant.

The arms are first composed of a joint near the body, extending a little outward, and moveable in every direction. To this is attached the arm, which is smooth, and somewhat powerful. Next this is the fore-arm, and next it are the feet, which have three hooks, a small one on each side, and a larger in front. Between each of these is a powerful joint, and they are confined to a large angle, as they cannot be extended into a straight line. When the animal, therefore, has made the sides of his cell in a circular shape by the gluten from his mouth, and a quantity of pipe-clay, which he frequently employs in the building of it, he applies his body to it, and, placing the fore-arms around it, at an angle most convenient for itself, he continues to rub up and down till the shape has been given to the cell. The first angle is formed by the body and the arm; the second by the arm and fore-arm, and the third on each side by the angles formed by the fore-arm, and the feet or claws.*

In proof of this, it may be remarked, that the bottom of the cells is round, and the hexagonal form does not commence till the cell has attained a sufficient height to admit of the application of the animal's body and legs to the outside of the cell, after which, to the top of the cell, the hexagonal form is remarkably distinct. Besides, to leave no doubt about the matter, we have measured the legs of a full grown hornet, and then applied them to the sides of the cells, and out of 160 cells in one nest, found only half a dozen near the outside, that did not correspond exactly with the length of the arm or fore-arm, and these were probably injured or dried up.

In this respect, therefore, I think, that instinct may be pushed one step farther back from the demesnes of philosophy, since this very complicated and regular exhibition of animal sagacity may be accounted for from the organic structure and formation of the animal. The wonder still remains, why it should have been constituted with such powers. But this wonder is in common with that of every thing around us; and is continually excited in examining the wonders of the lower creation, especially in entomology, which, in this country, above all others, would require the united energies of a score of naturalists for many years. Its treasures are inexhaustible, and are almost entirely unknown.

When upon this subject, allow me to allude to a circumstance connected with the beautiful *Atropus Belladonna*. This butterfly, in the state of a grub, as it is here called, forms a pyramidal and sometimes a circular nest of small twigs, which it may be seen oc-

* The figure is considerably larger than nature.

casionally dragging up a tree, by short and easy stages. This is the case with the same insect when very small; but, in both stages, it may be seen moving about its head before it commences its journey, and stopping at regular intervals as if to reconnoitre. One unacquainted with its natural history, might suppose it was apprehensive of danger. But the fact is, that when it moves its head from side to side, it is spinning for itself a thread, which it fixes to the tree, and, when it is strong enough, it stretches out its fore claws, seizes hold of the thread, and raises itself upward, on the principle of the common rope-ladder. When you examine its path attentively, you see these steps placed at the most regular distances, as regular as if made by the hand of art, and intertwined in such a way, that if one should break, the next will keep the animal up. This is certainly instinct in one sense, but is common mechanics in another. For the animal seizes hold of the thread by the second pair of feet, stretches his head upwards, and makes the distance between the two steps of the ladder precisely that of the distance between his mouth and his second pair of arms, which is exactly one-fifth of an inch in a common sized animal. We have watched him ascending a smooth surface by this means, when it would have been thought impossible to raise a large circular cylindrical nest with so much despatch on such a surface. Such paths you have probably yourself seen long ago.

Ascribing effects to instinct, therefore, is a great source of error in natural history, and should not be resorted to, except in those cases in which no rational account can be given of the effect we contemplate; for if men were to stop short at second causes, every effect in nature might be denominated instinctive. The best possible means have been always adopted to produce the best possible ends. It is the business of philosophy to discover the latter, and trace them by that means to the grand intelligent source from whence they originated. I am, &c. [*Edin. New Phil. Journ.*

Sketches of the Progress of Inventions, connected with Navigable Canals. Compiled from various sources.

[From the Boston Journal of Science.]

The triumphant progress of the Great Western Canal, begun a few years since, by the state of New York, has fixed the attention of the public to works of this kind, in a degree, perhaps, unprecedented in any other country. In every district of the United States, canals are projected, and such are the supplies of water, and so favourable are other circumstances, that very few of the projects appear either chimerical, or, at least so far as the public is concerned, useless.

This advantageous mode of intercourse and traffic, is, in some of its most important parts, of modern invention; although some of the canals of the ancients were designed for commercial intercourse,

and on all it might have been practised in a degree; yet, irrigating and draining the land were the ends proposed by most of the canals, known in the early ages. The limit which the state of knowledge fixed to all works of this kind will be fully perceived, when it is recollected that locks, and, consequently, different levels, were unknown until within a few centuries. The ancient canals, therefore, were no more than artificial rivers, which could be made only through countries nearly level, and which, in cases of deviation from that direction, not only presented the obstacle of rapids to the passage of boats, but required constant attention and labour, to preserve the embankments from destruction, and, perhaps, the neighbouring country from inundation. Such were the canals of India, Egypt, and ancient Italy, and such, at this day, are the canals of China. Notwithstanding, however, the imperfection of these works, from the want of knowledge, some of them were formed on that scale of grandeur which so strongly characterizes the productions of ancient art. There seems to be good authority for believing, that the Red Sea was once united to the Nile, by a canal. One entrance of this canal is said to be yet remaining. The canal of Alexandria, which united that city with the Nile, still exists, although in a ruinous state. Formerly, the productions of Egypt were carried through this channel to Alexandria, thus avoiding the dangerous navigation of the mouth of the Nile, from whence they were shipped to Europe. The whole number of canals in Egypt, is said to have amounted to eighty, some of which were forty leagues in length, and in some places nearly three hundred yards in width. The Greeks have left no great works of this kind; at least none for the purposes of navigation. A cut through the isthmus of Corinth, which would make a navigable passage from the Ionian Sea to the Archipelago, though often proposed, was never effected. The canals of ancient Italy were neither numerous nor extensive. They were designed for the double purpose of drains and navigation. Such were the canals of the Pontine marshes, and those in the neighbourhood of the Po. In England, however, a Roman work, now called the Caerdike, formerly united the Nyne, near Peterborough, to the Witham, below Lincoln. It was nearly forty miles in length, and from the ruins, which still remain, must have been very broad and deep. Another canal, supposed to have been a Roman work, is still navigable, and connects Lincoln with the Trent, above Gainsborough, by one level of eleven miles. These canals are both situated in the English Fens, and are, of course, natural levels.

It has been observed, that locks were unknown to the ancients; they are still unknown to the Chinese. Some of the canals of China, however, are constructed on different levels, and their method of passing boats from one level to another is worthy of attention. The levels are connected by inclined planes, constructed of hewn stone. These inclined planes, in some instances, connect levels differing fifteen feet in elevation. In passing from the upper to the lower canal, the boat is raised out of the water and launched over the inclined plane, the last part of the operation, of course, requiring no great

labour, as the friction over the plane retards the descent of the boat. But in passing from the inferior to the superior canal, powerful engines are required. These consist of capstans, from which ropes are passed round the stern of the boat. The effort of a hundred men is sometimes required to effect the elevation of a loaded boat. The objection to this mode, taken in this simple and rude form, lies not only in the great labour required by it, but in the injury which must necessarily be done to the boats. The practice could never be adopted with the slightly timbered barges used in our canals, which are calculated to be supported by the fluid in which they move, and which presses with a force perfectly equal on every part with which it is in contact. There are some situations, however, where, from a scarcity of water, the inclined plane is necessarily substituted for the lock. Some works of this kind, are used on the continent of Europe; and in England, in some cases, where the weight of the descending, greatly exceeds that of the ascending commodities, as in the traffic between mines and furnaces, inclined planes are used with advantage. In these situations the descending and loaded boat, is made to drag up an ascending one, which is empty, or but lightly loaded, thus exhausting in a useful purpose, a force which not being expended in friction, as rollers or wheels are used between the boat and the plane, could not be otherwise controlled without some labour and cost.

In enumerating the improvements in canal navigation, we shall commence with the lock. The period when locks were invented does not now seem to be precisely known. On this subject, the writers in the Edinburgh Encyclopædia say, "We have been at some pains to trace the original discoverers of this important engine; and though our researches have not yet been attended with all the success we could wish, yet we have been enabled to acquire some new lights respecting the early history of an invention, which three centuries, perhaps four centuries, have not yet brought to its ultimate perfection. Belidor, in his *Architecture Hydraulique*, supposes the invention to belong to the Dutch, from some expressions used by Stevinus, an eminent engineer of that country, in his treatise *Sur la nouvelle Maniere de Fortification par Ecluses*, published in 1634; but that superficial inquirer does not seem to have comprehended the particular invention which Stevinus describes, who expressly says, that locks of the modern construction, a figure and very correct explanation of one which he gives, had been known in Holland from early times. His object was to describe a new kind of sea lock then lately invented, for the purpose of securing the harbours, and which might at the same time admit the passage of masted vessels. The difficulty was, to form gates which could be opened when the water on their two sides was at different levels. The inventions of several engineers there mentioned are described, and the preference given to the plan of turning gates, placed so as to fill up the frame of the common gates, and which, when let go, fall into the line of the stream.

"Stevinus first gives an account of the common mode of effecting

the first object, as it had been in use for a long time, viz. the raising a common sluice door by a windlass, which, he says, does not allow the passage of masted vessels.

"2. He describes the sluices used for draining low lands, consisting of two doors, butting against the tide and shutting of themselves, which, he says, are more useful than raising the sluices, because they admit of being larger, and require no attention to watch the tide; but, he says, they are also defective in not admitting masted vessels, when they are placed under the dyke, and in not retaining water to scour the channel.

"3. The third kind of sluices, serving to pass masted vessels, are made with two pair of pointed doors, like the second, but raised as high as the dykes themselves, comprising between them a receptacle for ships, with two small sluices made in the walls, or in the doors themselves. Then he describes briefly the mode of passing a ship through the locks.

"Besides these, he says others have been made which open of themselves, with the ebb falling on the bed, and rise with the flood; also gates which are drawn aside into the land, but their use is not convenient.

"Stevin also informs us, that he and several other engineers had agreed to study this subject, and communicate their inventions to each other. The following was the result:

"Adrian Janssen, carpenter of Rotterdam, invented the locket for holding a turning gate in its place. A turning gate had been made at Briel, which was retained in a groove at the bottom, out of which it was wound three inches by a rack, ere it could turn into the line of the stream.

"Stevin's mode was to have rising vanes the whole width of each butting lock-gate; Cornelius Dirricksen Muys of Delft, to have second lock-gates holding up the first; and Adrian Dirricksen of Delft improved Janssen's mode, by applying them in folding gates. He got a patent for it from the state, and built two at Maeslandsluis and two at Helvoetsluis of that kind, which yet exist. Stevin's whole account of this mode of securing harbours is well worthy of attention.

"Of the Italian authors, the first who enters into the history of the discovery, is Zendrini, in his treatise *Della Acque Correnle*, published in Venice, 1746, who says, that being interested in ascertaining the original inventors of locks, he had taken some pains to search the Venetian annals on the subject, and found that the first lock was invented at Stra, near Viterbo, by two brothers of the name Dominico, clock-makers, in Viterbo, who had a patent for its construction from the senate of Venice, in the year 1481. The patent describes, that these engineers had engaged to construct a sluice, (concha,) in which boats might pass without danger, and which being so contrived, that the water passing out with facility, the vessels would neither be required to be discharged nor drawn over. This account has been acquiesced in by Lalande and other writers; but Lecchi, in his book *Dei Cannali Navigabili*, alleges that, previous to this

period, in 1420, the lock had already been introduced in the navigation of Milan, by Fillippo Maria Visconti, as mentioned in his life, by Decembrio, one of his courtiers. And in 1188, Petentino, the architect of Mantua, had thought of it on his dykes on the Mincio, at Governolo, the first attempt at overcoming the fall of rivers in all Italy; so that Lecchi claims it for Lombardy. Nevertheless, there is every reason to believe that these cases were nothing more than the wear and single flood-gates already used for the navigation of rivers; for Bertazzolo, in his discourse upon the sluice of Governolo, published at Mantua in 1609, proposes a lock with a chamber, (sostegno,) to be built at the sluice of Governolo, as a new thing. This lock has since been established on the left bank of the Mincio; and, connected with an opening wear, it serves to hinder the turbid waters of the Po from filling up the lower lake of Mantua, while at the same time it preserves the navigation. Indeed, in many parts of Lombardy, wears with flood-gates are yet employed for river navigation, although locks exist of an early date, and some of them also of singular magnitude and boldness. To conclude, we may observe, that at all events, a very few years after the supposed invention in the Venetian state, the celebrated painter, architect, and engineer, Leonardo da Vinci, in 1497, applied locks to connect the Milanese canals derived from the Adda and the Tesino.

"We must next consider the claims of Holland, that other great cradle of the hydraulic art of Europe. We have formerly noticed, that the embankment of the different districts of Holland had chiefly taken place between the years 1000 and 1400. In 1253, a placart was granted by William, Earl of Holland, to the city of Haerlem, for the construction of the sluices of Sparendam. Those sluices must have necessarily been a lock; for it is expressly said to be constructed for the more convenient passage of ships, and a toll is appointed to be collected on the vessels which make use of it.

"About the same time, viz. 1255, the jurisdiction of Deftland, was established, and the ancient canal from thence to Leyden, completed. On this canal, at the separation between Deftland and Rhineland, is the basin of Leidsendam, which, as we have already observed, becomes, to all intents and purposes, a complete lock, by means of the stop-gates belonging to the two jurisdictions at either end, and it has always been used as such.

"At the same period, the citizens of Utrecht had formed an aqueduct from the river Lech at Vreeswyck; and in 1371, as we are informed by Hada, in the History of Utrecht, they deepened and enlarged this aqueduct, so as to make it navigable, and placed at the bank of the river Lech double flood-gates, or stop-gates of timber, by which the waters might be more easily kept out or introduced. (Hedæ *Hist. Epist. Ultraj.* Arnold. ii. *Episc.*) The structure was certainly a lock, as we see by a note upon the passage, describing an improvement which was made within the same century by the addition of a third gate, thereby converting it into a double lock. From this note, it is evident that the original structure permitted the passage of vessels, which William only rendered more secure during

the high floods of the lock, by the construction of the third gate on the side next that river, thereby forming two chambers instead of one; and by the care that is taken to mention the name of this artist, it appears that the original or single lock was not considered as any new invention. There is, therefore, strong reason to believe that in Holland the lock was known, and in use, at least a century before its application in Italy."

The construction of locks is not yet, perhaps, brought to that degree of perfection of which it is susceptible. An easy passage for the boats, durability, and the least possible expense of water, seem to be the principal ends to be had in view in forming locks. Some of the locks on the most celebrated canals, built a century or two ago, are very deficient in some of these particulars. Such, for example, are those on the canal of Languedoc, that noble work which unites the Atlantic to the Mediterranean. These locks are oval, or in some instances, of a circular shape, in the plan; forms adopted from a false idea that the pressure of the earth behind the walls would thrust them inwards. The consequence of this form is, that a large quantity of water is lost on the passage of every boat. The effect of the earth to overthrow walls built straight on the horizontal line, has been proved by the permanence of subsequent works, built in this manner, of no great amount, when they are otherwise properly constructed. The walls should always be built of masonry, if, indeed, iron should not eventually be introduced. The profile or figure given to the lock, as represented by a cross section, is of great importance, as on this the stability of the walls, in a great measure, depends. The walls should retreat or batter, as they rise, the batter being more considerable at the bottom, and decreasing as the walls ascend; at their summit they become nearly vertical. An inverted arch, sprung from the bottom of each wall, gives them an admirable support, preventing them from sliding inwards, and against this it is necessary to have some guard.

[to be continued.]

Account of Excavations made at Pompeii, from December 1826 *to August* 1827. *By* T. C. Ramage, Esq.

It was in the autumn of 1825 that I first paid a visit to Pompeii, and the impression it then made on my mind was by no means equal to what I had expected. I returned, however, several times, and found that every examination only increased my desire to investigate it more minutely. You are aware that Pompeii is about fourteen miles from Naples, and five from the crater of Vesuvius. Through it ran the Via Consularis, a branch of the Via Appia, which, striking off from Capua, passed through Naples and Pompeii, to Solerno. On entering the suburbs you set your foot on this ancient road, which, like all the other Roman ways, is composed of large unhewn blocks of stone. In Pompeii the pavement has been composed of lava, and

shows that Vesuvius must have been a volcanic mountain in some early period of the world, though history has left us no account of it. Alighting at the barrier, where a guard is placed, you enter its suburbs, which have been called Augustus Felix, and appear to have been founded by the colonies of Sylla and Augustus, whose names have been discovered on many of the monuments. One single villa has been completely excavated, and many others no doubt surround it, which will hereafter be exposed to view. The first coup d'œil is remarkably striking, and well fitted to make an impression on the mind; you see at once the whole length of the street, which is lined on both sides by tombs, some entire, and some in ruins. They are chaste in decoration, classical in design, and prove that they must have been erected before the taste of the Romans had become corrupted by the love of magnificence and grandeur, which they carried even to the grave. There rest whole families in eternal repose, as if they were still enjoying themselves around their Penates, and solemnizing some of those annual ceremonies in which all took a part. The mother is there stretched at the side of the father, and the children, according to their several ages, in regular order beside the mother.

Some of the tombs are most magnificent, and have been erected by a grateful country to citizens whose merits had entitled them to such a distinction; they are adorned with the palm and the laurel, and present the elegant forms of the lectisternium and bisellium. These noble monuments may be considered as altars erected by the Genius of Arts to the honour of Mystery and Death.

It was here that the inhabitants enjoyed themselves at even, under the shade of the cypress, which waved its mournful head over the tombs of their ancestors; it was here that they caught those genial breezes, which were so grateful after the heats of the day. What a strange contrast must their games, diversions, and tumultuous joy, have formed to the calm and silence which reigned in the graves where slept those who had once been as gay and as merry as themselves!

But as you have most probably seen a detailed account of the discoveries made previous to December 1826, I proceed now to give a short view of the progress that has been lately made in disinterring the ancient city of Pompeii from December 1826 to August 1827.

At present there is every appearance that we have at last advanced to a part of the town occupied by the more opulent class of citizens, and we are in hope of making some valuable acquisitions to our stock of antiquities. The streets have become more spacious, and the houses begin to have an air of splendour and neatness, far exceeding that of the houses situated along the sea coast. Indeed, as we know that the shops and taverns must have been in the vicinity of the Forum and public buildings, and as these are almost the only edifices that have been as yet uncovered, we may conclude that the private villas are still concealed from our view. The articles that have been found in these houses are generally superior, both in richness of ma-

terial and beauty of workmanship, to any that the Royal Museum has yet acquired, and display, in a very remarkable manner, the labour and ingenuity bestowed by the Romans, even on their commonest utensils.

The excavations have taken place principally in two directions,—in that street which is called the Street of the Arch, and towards the angle of the Forum, opposite the Basilica. In the winding lane which leads to the portico of the theatre, there have been several small houses excavated, exhibiting a considerable degree of ingenuity in the just arrangement, and agreeable union of all parts of the edifice, and a most extraordinary economy in the employment of ground. It may, indeed, be affirmed of them, what Pomponius Atticus said of some old houses he possessed in Rome, that there had been more ingenuity than money expended in their erection. One cannot help admiring the solidity with which many parts have been built, and the beauty of the *opus reticulatum*, which is equal even to the celebrated specimens of this sort of work, in the gardens of Sallust, at Rome. Here, also, were found several Ionic chapters, of a style purely Grecian, which you know is a very unusual occurrence in Pompeii. Their volute resembles the calyx of a flower, attached to its stem, which, turning downwards at the point, where the junction of the volute takes place, winds round the higher part of the shaft of the pillar,—an elegant device, quite new to us.

In the street of the Arch, the houses are larger and more splendid. One of them has its front decorated with representations of baskets, carved in a grayish coloured volcanic tufa, called by the Italians, Tufo of Nocera, from the quarries being discovered in the vicinity of that town. These baskets, exhibiting great accuracy of outline, are still, in some parts, covered with the stucco, which had been applied to them to furnish moulds for others intended to imitate the tufa. The cornice, formed of the same material, is lying on the ground, and furnishes a beautiful specimen of elegance in architectural disposition. On entering this house, we look across the atrium and the summer parlour. At the bottom of the peristylium, there is a fountain encrusted with shells and glass mosaic, similar to the one excavated some time ago. Near the outer door there is a small staircase, leading to the upper story, or rather to the roof, as its diminutive size prevents us from supposing the architect could intend it for any nobler purpose. The atrium is Tuscan, painted grotesquely with little flying figures on a red ground: among them the most remarkable are the figure of a winged female, with a garland of flowers in one hand, and a young boy in her arms; a little figure of a female in flowing drapery, with a palm branch in her hand; and a harp-player seated at her instrument. In the summer parlour, enriched by a beautiful mosaic pavement, the walls are ornamented with a variety of fruit and richly plumed birds. The portico, furnished with only two rows of pillars, has, on the opposite walls, a representation of the same number of columns, corresponding with the real ones, and between them there are landscapes sketched with great spirit, and of a much larger size than any hitherto discovered.

These are chiefly views taken on the sea-coast. On the left appears a large harbour, with several vessels at anchor: there is a building erected on a small island, united to the adjoining land by a singular bridge, which is approached by means of a stair, removable like a draw-bridge. In front is seen a two-oared bark, with sails exactly similar to those used at present in the Bay of Naples. At the side of this there is a building constructed on some rocks in the middle of the water, with a fisherman seated, and in the act of drawing his net. Among many other sketches there is one of a man on horseback, followed by a large dog, and wearing a hat which bears a considerable resemblance to those pointed ones which the peasants of Campania have at present. In the centre of the colonnade opposite the door, there is a fountain, in the form of a small altar, with its niche and top richly decorated with mosaic and shells. In the middle of the semicircular basin of this fountain, there was found, on a round pedestal, a little winged boy of bronze, with one hand raised, and embracing with the other a goose, which was in the act of flapping with its wings, and ejecting a stream of water into the basin. Towards the centre of the niche there is in the wall a scenic mask, from the mouth of which flowed another jet of water; and on the edge of the basin there was found another statue of bronze, three palms high, representing a fisherman seated with a small basket of fish in one hand, and extending the other, in the act of raising the net. From a rock completely encrusted with shells, on which the fisherman is seated, another jet of water has evidently been thrown. The features of this little figure are strongly marked, and full of expression. Besides a Caryatides of marble, there was found another figure of the same material, representing a young fisherman asleep, and covered with a sailor's mantle, such as is generally worn by the fishermen of the present day. The remains of the leaden pipes, with their stop-cocks, are plainly seen. In this house there was also discovered a beautiful marble table, of Greek workmanship.

Many rich candelabra, bracelets, rings, ear-rings, and medals have been the reward of these excavations. But the most curious discovery of all, is that of two glass vases, one of which contained olives, with the oil in which they had been placed eighteen centuries before; and the other nothing but pure oil. It may not be uninteresting to give the chemical analysis of these substances, by Professor Covelli of Naples.

Analysis by Professor Covelli.

The olives were found in a quadrangular glass vase, with a large mouth. The oily substance was inclosed in a cylindrical glass vase, with a narrow neck, and a small handle.

Examination of the Olives.—The upper half of the vase containing the olives, was full of volcanic ashes and pebbles; the olives, mixed with a kind of buttery substance, occupied the lower half. They have the form and size of that variety commonly called Spanish Olives; some of them have even still their *pedunculus* or flower-stalk. The kernels are less oblong than those of the Neapolitan

species, and also more swollen; the longitudinal streaks are more strongly marked. Their colour is black, but mixed with small particles of a greenish matter, which, with the aid of a powerful lens, it was discovered were those lichens produced on organic substances in a state of putrefaction; but these little plants were not observable at the moment of their discovery, and have no doubt arisen from the action of the air, which, in a few hours, had produced such an alteration in their superficies, as had not been accomplished by the influence of so many centuries. This is a proof that these olives, gathered eighteen centuries before by the subjects of Titus, are as fresh and sweet as those produced by Francis I. Indeed, these ancient olives are still soft and pulpy; they have a strong rancid smell, a greasy taste, and leave upon the tongue an astringent and sharp sensation. They are so light, that they swim upon water; the pericardium or seed-vessel shows still its organic texture, though the parenchyma is in that state of alteration which the maceration of a few months usually produces. The kernels are still hard; so much so that a knife can scarcely penetrate them. The oily part of the parenchyma, though in very small quantities, when analyzed carefully in the usual method, has been found to be changed entirely into oleic and margaric acids, which are the fundamental principles of the fixed oils, acidified by oxygen, and form the basis of our soaps. These changes happen generally in oils exposed for some time to the air. This proves that the action of eighteen centuries, which has left untouched the fundamental principles of the oil, has effected no greater change than what is produced by a few months.

The kind of oily substance in which the olives are enveloped, is of a brownish-yellow colour, soft like butter, has a strong rancid smell, soils paper like fixed oils and greasy substances, is melted by a moderate heat (60° or 70° cent.) warmed on a leaf of platina; it burns with a beautiful white flame, without leaving any thing but small, white, flaky ashes, so light that the smallest puff disperses them. With the alkalies it forms soap; distilled in close vessels, it gives out carburetted hydrogen gas, acetic acid, carbonic acid, carbonic acid gas, and a residue of carbon. This buttery substance, tried by Cheuvreul's method, is found to be composed of oleic acid in large quantities, a small portion of margaric acid, and a substance analogous to the sweet principle of fixed oils, but which differs in many respects, and which may be a new production; and, lastly, an earthy substance, in very small quantities, arising from the volcanic ashes which filled the upper half of the vase.

Examination of the Buttery Substance found in the narrow-necked Vase.—This substance is much softer than the preceding: it has a yellowish-green colour, has a strong rancid smell, and exhibits in the mass a number of brown globules, similar to the spawn of fish, but which cannot be made out even by a powerful lens. This substance resembles that found with the olives: it is composed of the same principles, though it may contain a larger quantity of oleic acid, and of that unknown substance analogous to the sweet principle of fixed

oils. It appears, indeed, to have been nothing else but the oil of olives, containing some vegetable salt.

[*Edin. New Philo. Journ.*

On Sea Serpents and Colossal Medusa. Extracted from a letter from C. Telfair, Esq. *July 20th,* 1827, *to* R. Barclay, Esq. *of Bury Hill.*

I have read with great pleasure your very highly interesting communication about the sea serpent, as, also, the very profound and learned disquisition on that and similar subjects by your eminent friend, S. S. Duncan Esq. (of Oxford.) Every person who has been much in the Bombay trade must have seen countless shoals of sea serpents off that coast. I myself have seen them for hours accompanying the ship I was on board of, in 1809, when going to Bombay, and every person I have spoken to on the point here, has appeared surprised that any doubt could exist about it. Those which I saw, might be about 40 feet long, from estimation; they were beautifully coloured, and moved as rapidly as the ship, going seven or eight miles an hour: smaller ones still more common. On the coast of this island, an immense *medusa* was thrown on shore, in a violent gale of wind, in 1819; it was within seven miles of my Belomber estate. It must have weighed many tons. I went to see it when the gale had subsided, which was not for three days after its being cast upon the sand, but it had already become offensive, and I could not distinguish any shape. The sea had thrown it high above the reach of the tide, and I instructed the fishermen who lived in the immediate neighbourhood to watch its decay, that if any osseous or cartilaginous part remained, it might be preserved; it rotted, however, entirely, and left no remains. It could not be less than nine months before it entirely disappeared; and the travellers were obliged to change the direction of the road for nearly a quarter of a mile, to avoid the offensive and sickening stench which proceeded from it. [*Ib.*

Chinese Method of Fattening Fish.

The Chinese are celebrated for their commercial acumen, indefatigable industry, and natural adroitness, in making the most of every gift of nature bestowed on their fertile country. Useful as well as ornamental vegetables engross their every care; and animals which are the most profitably reared, and which yield the greatest quantity of rich and savoury food, are preferred by them for supplying their larders and stews. Their *hortus dietetica* would form a considerable list; and though they do not use such a variety of butcher's meat and fowl as Europeans do, yet, in the articles of pork, geese, and ducks, they surpass, in the use of fish they equal us; and

in their domestication and management of them, they excel all other nations. A few observations on their *piscinas*, or fish-stews, is the design of this paper; not merely as an historical description, but as an object for imitation in this or any other country. For twenty or thirty miles round Canton, and as far as the eye can reach on each side of the river, on which that city stands, the general face of the country appears nearly a level plain, with but little undulation of surface. The level is, however, richly studded with beautiful hills, which diversify the landscape, and seem to rise out of the plain so abruptly, that they form the most picturesque features, united with the most pleasing combinations. The soil of the plain consists of a pure alluvial earth, of great fertility and depth, and very retentive of water; which, by the way, is a proof that, notwithstanding their claim to high chronological antiquity, the waters of the deluge remained much longer (perhaps for ages) on this portion of the continent of Asia, than it did in the interior: and the circumstance of many of their hills being cultivated to the very top, their numerous water plants, and their almost amphibious habits as to their domiciles, are still further proofs that the country was once more of an aquarium than it now is. Hence the facility of making canals, which are their high-roads (as wheel-carriages and beasts of draught are too expensive appendages for the systematic economy of the celestial empire!) and hence the ease with which a pond may be made in any otherwise useless corner. Such tanks, or ponds, are generally met with in market-garden grounds, where they serve the double purpose of a reservoir, and a stew for rearing and fattening fish.—When a pond is made for this purpose, and filled with water, the owner goes to market, and buys as many young store-fish as his pond can conveniently hold; this he can easily do, as almost all their fish are brought to market alive. Placed in the stew, they are regularly fed morning and evening, or as often as the feeder finds it necessary; their food is chiefly boiled rice, to which is added the blood of any animals they may kill, wash from their stewing-pots and dishes, &c. —indeed, any animal offal or vegetable matter which the fish will eat. It is said, they also use some oleaceous medicament in the food, to make the fish more voracious, in order to accelerate their fattening; but of this the writer could obtain no authentic account.—Fish so fed and treated, advance in size rapidly, though not to any great weight; as the kind (a species of perch) which came under observation, never arrive at much more than a pound avoirdupois; but from the length of three or four inches, when first put in, they grow from eight to nine in a few months, and are then marketable. Drafts from the pond are then occasionally made; the largest are first taken off, and conveyed in large shallow tubs of water to market; if sold, well; if not, they are brought back, and replaced in the stew, until they can be disposed of. This business of fish feeding is so managed, that the stock are all fattened off about the time the water is most wanted for the garden crops. The pond is then cleaned out, the mud carefully saved, or spread as manure,—again filled with water, stocked with young fry, and fed as before.—An intelligent Chinaman,

from whom the writer had the above detail, and who showed him as much of the process as could be seen during a residence of three months, declared, as his belief, that a spot of ground, containing from twenty to thirty square yards, would yield a greater annual profit as a stew, than it would in any other way to which it could possibly be applied.—That fish may be tamed, suffer themselves to be caressed, and even raised out of their natural element by the hand, has been long known to naturalists; witness the famous old carp formerly in the pond of some religious house at Chantilly, in France, with many other instances on record. But it is probable no people has carried the art of stew-feeding fish, and practised it as a profitable concern, to such lengths, as is done by the Chinese at this day. [*Quarterly Journal of Science.*

On a Method of Cleaning Silk, Woollen, and Cotton Goods. By Mrs. Anne Morris.

[From the Transactions of the Society for the Encouragement of Arts, &c.]

Take raw potatoes, in the state they are taken out of the earth; wash them well; then rub them on a grater, over a vessel of clean water, to a fine pulp; pass the liquid through a coarse sieve, into another tub of clear water: let the mixture stand, till the fine white particles of the potatoes (the *fæcula*) are precipitated: then pour the *mucilaginous potato-liquor* from the fæcula, and preserve this liquor for use.

The article to be cleaned should be laid upon a linen cloth, on a table; and, having provided a clean sponge, dip it into the potato-liquor, and apply the sponge thus wet upon the article to be cleaned, and rub it well upon it, repeatedly, with fresh portions of the potato-liquor, till the dirt is perfectly loosened: then wash the article in clean water several times, to remove the loose dirt: it may afterwards be smoothed and dried.

Two middle-sized potatoes will be sufficient for a pint of water.

The white fæcula, which separates in making the mucilaginous liquor, will answer the purpose of *tapioca;* will make a useful nourishing food, with soup or milk; or serve to make starch and hair-powder.

The coarse pulp, which does not pass the sieve, is of great use in cleaning worsted or woollen curtains, tapestry, carpets, or other coarse goods.

The mucilaginous liquor of the potatoes will clean all sorts of silk, cotton, or woollen goods, without hurting the texture of the articles, or spoiling their colours.

It is also useful in cleaning oil-paintings, or furniture that is soiled.

Dirty painted wainscots may be cleaned, by wetting a sponge in the liquor, then dipping it into a little fine clean sand, and afterwards rubbing the wainscot therewith.

On a difference in the velocity of Intense and Feeble Sounds.

In some interesting remarks upon sound in the Edinburgh New Philosophical Journal, Mr. Meikle has called in question the truth of the received doctrine, that all sounds, whether loud, or faint, move with the same velocity. Although this is true, in ordinary circumstances, when the sounds have not much intensity, (as when we listen to distant music,) yet it may cease to be true with regard to the intense report of a cannon. Indeed, as Mr. M. well observes, theory would lead us to suppose that the enormous quantity of heat which accompanies the explosion, would increase the elasticity of the air, and the velocity of the sound, much more than in the case of sounds created by simple percussion.

It is true, that in this part of the world, no such difference has been observed, which may arise either from the comparison never having been carefully made, or from the difference of velocity being really inappreciable. In the frozen climates of the north, however, such a difference, if it exists, may be expected to manifest itself, for in an atmosphere, perhaps a hundred degrees of Fahrenheit colder than that in which European experiments have been made, the heat at the mouth of the cannon, is (relatively to the temperature of the air) very greatly increased. Such, I think, is the conclusion of theory, and such is, also, the fact, as appears from the following decisive observation, for which science is indebted to the Rev. George Fisher, the astronomer in captain Parry's northern expeditions. I shall give it in his own words.

"The experiments on the 9th of February, 1822, were attended with a singular circumstance, which was, the officer's word of command 'fire,' was *several times*, distinctly heard both by captain Parry and myself, about one beat of the chronometer, (nearly half a second) after the report of the gun; from which it would appear, that the velocity of sound depended, in some measure, upon its intensity. The word 'fire' was never heard during any of the other experiments. Upon this occasion, the night was calm and clear; the thermometer 25° below zero, the barometer 28.84 inches, *which was lower than it had ever been observed before at Winter Island.*"

The last circumstance was, probably, not accidental; and if it is possible, in our climate, to distinguish the velocity of the sound of a bell from that of a cannon, it is at a time of diminished elasticity of the atmosphere, indicated by a low state of the barometer, that the attempt is most likely to succeed.

[*Quarterly Journal of Science.*

Distances at which sounds are heard.

"I recollect being, many years ago, at the west end of Dumferline, and hearing part of a sermon then delivering at a tent at Cairninghill. I did not miss a word, although the distance must be something about two miles. It was the late Dr. Black, of Dumferline,

who preached, and who, perhaps, has seldom been surpassed for distinct speaking, and a clear voice. The sound was such as I should have expected, under favourable circumstances, at a quarter of a mile. The wind, which was steady, but moderate, came in the direction of the sound. I was riding westward, and at length saw the doctor finishing his sermon, otherwise I should have doubted whether he had been at such a distance. Whether the sound had run along the road, as in a tube, I cannot say. I recollect little of what sort of road it is; part, I think, has pretty good dykes, which, aided by the wind, might guide and confine the sound." [*Jamison's Journ.*

On the effect of Wind upon Sound.

Amongst other observations upon this point, Mr. Meikle says, "It is generally supposed that the relative velocity of sound and wind is not affected by the motion of the latter; but this opinion stands much in need of confirmation. It is clear, that the effect of wind or sound is very different from merely bearing it along, as a current in the ocean does a floating body. For, in this way, the intensity would undergo no sensible change; whereas, we know that, in most cases, wind annihilates sound when opposed to it, and magnifies it prodigiously, when moving in the same direction. The most natural inference which we can draw from this, is, that wind reflects sound in the opposite direction; something in the way that the tide sends the *bore* up a river. The tremendous explosion of the Stobb's Powder Mills, in 1824, showed, in a very striking light, how feebly, and to how short a distance, sound moves against the wind, whilst it is prodigiously strengthened to leeward. A moderate breeze then blew from the south-west, and, although in the opposite direction, the report was loud, and the houses sensibly shaken to the distance of thirty miles, yet at three miles to windward, very few persons heard it, and those but feebly. [*Ibid.*

Fall of the Lake Souwando in Russia.

This lake, situated in the parish of Sakkola, in the Russian government of Wibourg, and surrounded by the lands of the Barons Friedrichs, was near forty versts in length, and had the form of a Γ, or Greek G. Before the year 1818, it was separated from the lake of Ladoga by an interval about a verst in width, called Taipale, on which was a sandy hill; its waters flowed into the river Wuoxa, which united the lakes of Saima and Ladoga. On the 14th May, 1818, the waters of the lake Souwando, increased by the thaw and the tempests, overcame the natural dyke at the foot of the lake, threw down the hill of sand, rapidly flowed into the lower lake, carrying away all the surrounding grounds, and for ever destroyed the barrier which had previously separated them. A chapel and a countryman's house were carried away, with the pastures and meadows; the waters of the lower lake were much disturbed, and the surface covered with ruins. The level of the lake Souwando fell twelve archines and a half; its length is now only fifteen versts. Its waters no longer flow

off by the Wuoxa, but pass into the lower lake by several falls through a deep canal. The land which has been uncovered by the water is already cultivated, and the beauty of the surrounding country said to be increased.—[*Bull. Univ.*

An Examination of Mr. A. Spencer's *remarks on the Adhesion of Disks, published in the Franklin Journal for July.*

Fig. 1. Fig. 2.

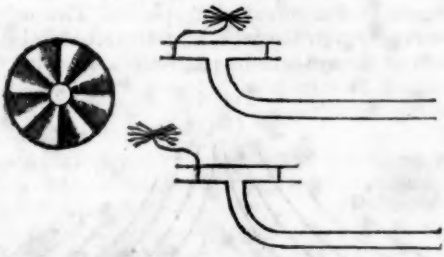


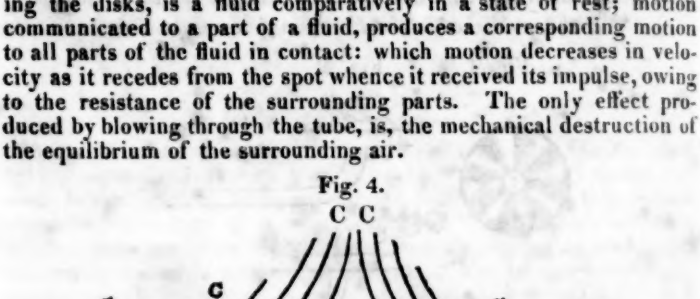
Fig. 3.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir,—In your July number, I have observed a theory respecting the adhesion of disks, by Mr. Asa Spencer. Towards the close of his remarks on the subject, he states that "the adhesion is not caused by any *flow* of air, but by the steady *pressure* of the atmosphere, which rested on them at the time the blast commenced, and continues unabated, while that on the inner surfaces is lessened by being met and opposed by the force of the blast, running out between the two inner surfaces of the cards." From a variety of experiments made, I am induced to adopt a theory directly the reverse of Mr. Spencer's: and think the adhesion is caused by a current of air falling nearly at right angles with the surfaces of the disks, at, and within their circumference; the velocity of which current is greatest at, and without the circumference. To test the truth of my theory, I have made use of the modified instrument here described. Take two circular pieces of sheet copper, about one inch in diameter, place them asunder about the eighth of an inch, with their surfaces parallel; retain them in this position, and in the centre of one of the plates, introduce a bent tube about the eighth of an inch in diameter; place through the upper plate a bent wire with a very fine point, that may be moved by the finger either over the centre of the plate, or at a point a short distance beyond the circumference: upon the point of this wire as in Fig. 2. immediately over the centre of the upper plate, put a small fan, such as communicates motion to a smoke jack, three-eighths of an inch in diameter; (see Fig. 1.) in this position of the fan, however great the blast, it will not revolve; next move the point outside of the circumference, and place the same fan upon it as in

Fig. 3, and by a comparatively slight blast through the bent tube, it will revolve rapidly. It does, therefore, appear, that at a short distance within the circumference of the disks, on their outward surfaces, there is little power exerted to induce adhesion—but upon a belt formed by the circumference, and an inner concentric circle, the power is exerted. The drawing, Fig. 4, with the following description, will fully explain the theory. The atmosphere surrounding the disks, is a fluid comparatively in a state of rest; motion communicated to a part of a fluid, produces a corresponding motion to all parts of the fluid in contact: which motion decreases in velocity as it recedes from the spot whence it received its impulse, owing to the resistance of the surrounding parts. The only effect produced by blowing through the tube, is, the mechanical destruction of the equilibrium of the surrounding air.

Fig. 4.



When the air is moved in the direction from A to B, its greatest velocity is immediately at A, as it leaves the disks; and continues to decrease, gradually, as it approaches B. This lateral motion destroys the equilibrium of the surrounding air, and causes a concurrent draft to fall upon the surfaces of the disks in the direction of the bent arrows from the ends marked C, to the barbs, which draft of air increases in velocity from C to the barbs, at which place it *nearly* equals the *velocity* of the *lateral current*. Now the pressure of air, between the disks, tending to separate them, is only as the *area of the tube*. The power inducing the adhesion, is the accumulated pressure, by a current of air moving with *nearly* the same velocity as that from A to B, exerted upon the *whole circumference* of the disks, in the direction of the bent arrows.

In consequence of the lateral direction of the current of air, as shown in the direction of the straight arrows marked D, or, rather, the obliquity of this current, the small fan would not revolve when placed on the centre of the plate: but, when brought under the accumulated draft at the circumference, moving nearly at right angles with its surface, it revolved rapidly. W. C.

ENGLISH PATENTS.

Patent granted to Henry Aspney Stothert, *of Bath, Founder, for improvements on, or additions to, Ploughs. Dated April* 4, 1827.

The plough represented in the drawing of the specification of this patent, has two wheels under the head of the beam; one of which, that is intended to go on the unploughed part of the field, is smaller than the other; and has besides the axle of this wheel, fastened to a dove-tailed block, that is made to move up and down in a similarly shaped vertical groove, as required, by a vertical screw that turns in the solid dove-tail, and has a winch at its top, which, besides its usual office, is made to serve as a stop to prevent the screw being moved from its proper position, by a pin that passes downwards through its handle, which comes in contact with the frame work to which the wheels are attached, when not drawn upwards, so as to permit the winch to move above it.

At the upper part of the same frame work, but nearest to the side next the large wheel, a nut turning on another vertical screw sustains a metal ball, that is embraced by a socket, which is attached to the head of the beam by a collar joint, that admits the beam to be moved round its own axis, while the ball and socket joint allows of a circuitous motion horizontally; and as the regulating nut of this latter screw is raised or lowered, the ball that is attached to it elevates or depresses the head of the beam, and thereby determines the depth to which the share enters the earth. The wheels, and the frame work mentioned, and, indeed, all the other parts of the plough, except the beam and handle, are made of iron; we only mention one handle, because but one is represented in the drawing, though some parts of the text make the intention of this doubtful.

The part to which the horses are attached, and which is somewhat similar to the same part in common ploughs, is fastened to a short horizontal bar, through which two vertical bars pass, to which it is fixed by moveable pins, for which holes are provided in the bars; by means of which the point of draft can be raised and lowered, as may best suit the height of the horses; and from the parts just described a connecting rod proceeds to the body of the plough, which has a short piece fastened to it that joins it to the beam also, at about one-third of the length of this latter from the coulter.

The turn-furrow of this plough is an iron plate curved into a form somewhat similar to the mould boards of the most approved ploughs, but which differs from them in having its curves so constructed, that a ruler or right line applied to any part of it, either vertically or horizontally, when it is in its proper position, will touch its surface in all parts. This plate has one set of perforations made through it that are long and narrow, to admit the air to pass, which the patentee states will have the effect of preventing the earth from sticking to it; and another set that may be either square or round, by which the iron stem of a short curved blade or knife, may be fastened to it in different places by a nut, so as to project from it horizontally at

right angles, to cut the furrow into slices; two or more of these knives may be used at the same time, to increase the number of the slices as required.

All the apparatus described may also be used with ploughs that have only a single wheel. [*Ib.*

Patent granted to DAVID BENTLEY, *of Eccles, Lancashire, Bleacher, for an Improved Carriage Wheel.* Dated May 8, 1827.

THIS carriage wheel is framed in a peculiar manner, with a view to make it altogether stronger, and to remedy the defects of the common nave, that is much weakened by the mortices made in it for the spokes, which come so close together, as to leave a much smaller portion of wood, to connect the parts at each side of them, than is generally supposed.

The metal box of the wheel in Mr. Bentley's mode of construction is larger than that commonly used, and has as many semi-cylindrical grooves, or shallow channels, made parallel to the axle at the surfaces of its two extremities, as there are spokes in the wheel, one half of the number being made at one end, and the other half at the other end, and so arranged, that the divisions between the semi-cylindrical grooves at one end of the box, shall be opposite to the central bottom lines of the similar grooves at its other extremity; the box has besides, four pieces about an inch high and broad, and about half the length of the box, projecting from its middle at right angles to each other, whose use is to keep the nave from turning on the box.

The wooden nave being firmly driven on the box so prepared, has excavations made at right angles to the axles at each of its extremities, opposite to the semi-cylindrical grooves; each of which excavations is fitted for the reception of the butt of a spoke, in such a manner, that the inner ends of the spokes may come closely in contact with the grooves of the metal box, while their outer extremities shall terminate in the plane of the rim of the wheel, close to the iron tire; and as this plane passes through the centre of the nave, every pair of the spokes, will, when viewed across the wheel, appear to form two sides of a triangle, of which the nave is the base, and will, in fact, give the wheel all the strength sideways, which triangular framing is ever found to produce wherever it is introduced. A circular metal plate is then placed, vertically, on the axle at each end of the nave, having cavities made at their centres to admit of this arrangement, and being perforated opposite to each division between the spokes in two places for the transmission of iron screw bolts; which passing across between them through the nave, are drawn tight by nuts, so as to press the plates against the ends of the nave, and firmly secure the inner extremities of the spokes, against the sides of which they are also pressed by the action of the nuts on the screw bolts.

The iron tire or rim of the wheel, is one continued hoop, and is made hollow at its inner side next the felloes, and rounded at its ex-

ternal surface, so as to present a nearly semi-circular section, if it were cut across in any part; the felloes are fitted so as to lie close to the internal cavity of this hoop, and when the several parts of the wheel are to be put together, after being fitted to each other, the outer extremities of the spokes are first put into the mortices made for them in the felloes, then these latter are arranged in their places, within the cavity of the hoop, after which, or at the same time, the inner ends of the spokes are placed in the cavities prepared for them, in the opposite side of the nave, and, lastly, the round end-plates are fastened to each side of the nave by the bolts; the nuts of which in being turned up tight, besides keeping the inner ends of the spokes in their places, as mentioned, will, according to the patentee, have the farther effect of pressing their outer extremities against the hoop, by causing the inner ends of those at the opposites sides of the nave to come closer together. All the nuts are placed at the carriage side of the nave, and, to prevent their getting loose by the motion of the wheel when in use, they are arranged so as to lie in two concentric circles a small distance asunder, and after they are screwed up tight, a ring that is made of the exact size of the space between the two circles of nuts, is fastened into it by wood screws, so that none of them can be turned again in any material degree until this ring be removed.

As the felloes are at first merely placed loose within the cavity of the hoop, as mentioned, some farther fastening and bracing will, of course, become necessary for them, and the method which the patentee takes for this purpose, is to place small wedges in two places at opposite sides of the rim, between their ends, pointing towards the rim, and a small screw bolt being put through each of these wedges in the same direction, and also passing through holes made for them in the hoop, are drawn tightly against this latter, by nuts at its outside, by which means the wedges are made to enter farther between the ends of the felloes, and thereby to press them against each other, so as to produce the intended effect above-mentioned.

The wheel is represented in the drawing that accompanies the specification, as having nine spokes, and nine pairs of bolts across the nave, in the intervals between their inner extremities. [*Ib.*

Specification of the Patent granted to Henry Constantine Jennings, *of Devonshire Street, Portland Place, in the county of Middlesex, Practical Chemist, for certain improvements in the Process of Refining Sugar.* Dated October 22, 1825.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Henry Constantine Jennings, do hereby declare the nature of my said invention to consist in a rapid and effectual mode of depriving raw or muscovado sugar of its colouring matter, by means of rectified spirits; and in further compliance with the said proviso, I, the said Henry Constan-

tine Jennings, do hereby describe the manner in which I perform my said invention by the following description thereof, (that is to say;) I wash raw or muscovado sugar in rectified spirits of wine, rum, brandy, or any liquor being principally alcohol, which has very little affinity to saccharine matter, or sugar, and a great affinity for colouring matter, water, treacle, &c., of which the impurities of raw or muscovado sugar consist; I use any conical vessel holding from 500lbs. to 1000lbs., having a wire copper guage or perforated bottom; and I assist the process, by using all and every of the well-known means, whereby liquids are made speedily to percolate through solid substances, whose parts are not in actual contact; these means are hydrostatic, hydraulic or hydropneumatic. When any spirit is passed through the mass of sugar, so as to drop no more, I pass about 30 gallons of saturated sirop through the mass of sugar; this removes all, or nearly all the spirit of wine, and leaves the sugar only moistened by the sirop, and ready for putting into the hogshead. The spirit, or rum, that has combined with the colouring matter and water &c. may be used again over inferior sugars, and after it is very thick, it may be rectified, and the spirit re-obtained in an uncombined state, without much loss. Now whereas, I do not claim as any part of my invention, either the conical vessels before described, or any part of the apparatus to be used in the process of refining sugar as aforesaid: but I only claim as my invention the application of rectified spirits, being principally alcohol, for that purpose, such rectified spirits having properties peculiarly adapted to the said purpose, and performing the operation of refining more rapidly and effectually than any liquor now in use for that purpose. And whereas such my invention, being, to the best of my knowledge and belief, entirely new, and never before used within that part of his said majesty's United Kingdom of Great Britain and Ireland, called England, his said dominion of Wales, or town of Berwick-upon-Tweed, nor in any of his said majesty's colonies or plantations abroad, I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects fully and without reserve or disguise with the proviso in the said hereinbefore part recited letters patent contained, wherefore, I hereby claim to maintain exclusive right and privilege to my said invention.

In witness whereof, &c.

Obs.—The process as described in the above specification for refining sugar, seems to us to be very ingenious, and we are inclined to think as well of it in every respect, as when we first noticed it in our 4th volume, present series, p. 319, in our remarks on the brevet or French patent, granted in May, 1808, to M. M. Derosne, who were the original authors of the invention. Since, however, in distilling the spirits from the coloured liquor that they have extracted from the sugar, a certain degree of waste and loss must occur, and as the process itself, must be attended besides with some expense, until the proportion of this waste, loss, and expense, to the value of

the benefit produced, be accurately ascertained, and laid before the public, it will be impossible to determine the economical result of the invention, in a commercial point of view; which alone can be considered when it is made an object of temporary monopoly.

We have likewise to remark, that an important impediment to the process in this country may be expected to arise from the interference of the officers of excise, who are not likely to permit spirits to be distilled or rectified, from any materials, or under any modification, however plausible may be the pretence, without their usual vexatious interference. [*Repertory.*

LIST OF AMERICAN PATENTS GRANTED IN JULY, 1828. *With Remarks by the Editor.*

Improvement in medicine; John Dent, M. D., Augusta, Georgia, July 2.

The medicine patented, is a compound forming Antibilious Pills, which, it is stated, have been proved, after long experience, to possess properties which render them more valuable than any of those before in use. They are prepared by Turpin and D'Antignac, of Augusta.

Improvement in the machine patented by Amasa Miller, February 18, 1826, for a method of constructing ways for drawing up vessels, and of applying the power in doing the same. Amasa Miller, New London, Connecticut, July 7.*

The advantages claimed by the patentee, are the removal of the ways from under the vessel, after she is hauled up, and the facility of replacing them when the vessel is to be launched, without lifting her from the position she is in; the using of a groove in the ways, as a substitute for ribands; there being iron cogs on the bottom of the cradle, which slide in the grooves on the tops of the ways; the economy with which repairs can be effected, and the small depth of water requisite for using the ways.

The improvement claimed in the present patent, are, 1st. Applying the power to the cradle, instead of swifting the vessel; and in this way entirely removing all strain, from the vessel, to the cradle.

2nd. The using keys, instead of braces, to secure the upper poppets.

3d. Having the cradle in two thicknesses, instead of using two sets.

An improved wind wheel, for grinding grain, and for pumping; Abner Murray, Athens, Bradford County, Penn., July 8.

This is a vertical wind-mill, with sails made of wood, tin, or sheet-iron, the wheel about 20 feet in diameter, the sails to be from 4 to

* By an oversight, the notice inserted p. 133, of the last number, was supposed to refer to the marine rail-ways, constructed by John H. Green, of New-London, instead of to the above. Of the comparative merits of the two we are not informed.

8 in number, and set at an angle of two and a half degrees. The shaft turns an iron wheel of 2 feet in diameter, and this, two pinions of 8 inches diameter, each of which carries a burr stone for grinding, of 14 inches in diameter. Each pair of stones stand vertically, one of them has a concave, and the other a convex surface. The stationary stone to have a hole in it, one and a half inches from the centre, to let the grain through.

When used for pumping, there is to be a crank to give a nine inch stroke to the piston.

The description of this machine is general, the patentee not informing us whether he claims the whole arrangement, or some particular parts only.

Improved manner of applying and attaching connecting pipes, or tubes, to the boilers of steam engines; Gideon Freeborn, New York, July 8.

The specification is as follows:

"The pipes are attached to the boilers, by bolts passing through the boilers to be connected, and lengthwise through the pipes. The bolts have a head on one end, and a nut and screw on the other end, or a nut and screw on each end, by means of which the boilers are brought in close contact with the ends of the pipes, and the whole held firmly together."

"Pipes put in, in this manner, can be cleaned or repaired with less difficulty than in any other."

Improved machine for dressing and jointing staves; Levi Benton, Hanover, Chataque County, New York, July 12.

This machine we shall hereafter describe at large.

A self-adjusting spring fastening for window-blinds, and shutters; Holly Seely, Unadilla, Otsego County, New York, July 14.

This is a kind of spring latch, consisting of a strap of steel, about 6 inches long, let into the under edge of the lower rail of a blind, or shutter, with a catch upon the window sill, and another on the wall, to secure it, whether open or shut. The end of the spring is bent so as to form a thumb piece, projecting inwards, to raise the spring, and open the shutter.

Contrivances for this purpose have become as numerous as sash-fastenings, ploughs, and washing machines, and in many of these the differences are so small, as *not to be seen by the naked eye.* If, however, they supply the wants of the patentee, and of the public, we shall not undertake the invidious task of interfering with either.

A machine denominated the rotary washer; Calvin Post, Spring-Port, Cayuga County, New York, July 15.

There is a cylinder of about 6 inches in diameter extending across the washing tub, or trough. This cylinder is fluted, and is made to revolve by means of a crank; above this, there is a second plain cylinder, having vertical play in its gudgeons; or else a hollow piece,

suspended as a rubber, and capable of playing vertically. The articles to be washed are allowed to pass between them, they being held, and turned about by the hand.

It is proposed to add a fly wheel to the cylinder, and sometimes to turn it by means of a treadle and pitman.

This machine has the merit of differing more than usual, both in its form and action, from most of its predecessors, but few of which have been sufficiently long lived to be introduced into society; we shall be happy to hear that this last born of the family is more fortunate. The only washing machine which appears to have received continued approbation, has been the simple, flat board, with flutes, or rollers, against which the clothes are rubbed.

A machine called the Longimeter, for the purpose of measuring a ship's way at sea; Abel Bayrd, South Reading, Middlesex County, Massachusetts, July 16.

The principle upon which this machine operates, is similar to that of Gould's Sea Log, invented about twenty-five years ago, and patented both in this country, and in England; and which was found to keep a ship's way with great accuracy. Gould's log consisted, mainly, of a spiral wheel, turning upon its axis by being drawn through the water. It was thrown over the stern of the vessel, and a line passed from it into the cabin; the revolution of the wheel, turned the line, which moved a train of wheels and indexes in the cabin. Many captains used, and approved it, and, we believe, that it was laid aside, principally, in consequence of the brass spiral wheel being frequently seized, and torn away, by sharks. Mr. Bayrd, has adopted a similar wheel, but instead of towing it astern, a water tight trunk is made to pass down through the hold of the vessel and into the water alongside of the keel. The spiral wheel, properly fixed to a frame, is made to slide down this trunk, so as to be exposed to the action of the water below the vessel. A rod, or pitman, moved by a crank, or eccentric wheel, on the shaft of the water wheel, extends upwards, and by means of levers and ratchet wheels, gives motion to indexes intended to show the vessel's way.

"The dimensions of the water wheel are, four inches length of cylinder; two inches its diameter; six inches length of axle; two inches depth, or width, of the wings, floats, or buckets; half an inch crank motion of the eccentric drum."

A machine for manufacturing paper in the sheet, by the dipping process; Marsden Haddock, New York, he having resided two years in the United States, July 17.

There is a horizontal shaft, or cylinder, on which there are fixed stumps or lifters, which give motion to seven levers, and these govern the principal operations of the whole apparatus. The mould and deacle perform their proper evolutions at the vat by means of one of them, and the others in regular succession complete the process. The paper is delivered from the mould on to an endless felt, is immediately carried under the press, which descends upon it, whilst another

is deposited ready to undergo the same operation; the pressed sheet is then carried on as the new one takes its place, and is removed by hand, to the drying room.

In the model, deposited in the patent office, the whole of the motions appear to be well performed, by means which are both ingenious, and simple.

Improved application of power to the common pump; Noah Underwood, Baltimore County, Maryland, July 17.

The power proposed to be employed is that of a dog, or other animal; the main object, it is believed, is to raise water for cattle, &c., upon plantations where it is needed. The dog is placed in a hollow drum, or wheel, like the turn-spit dog in former days; the wheel, of course, must be large to increase the leverage. A crank upon the shaft of the wheel, is connected to the pump handle, by means of a jointed rod, or pitman. It is the application of this jointed rod which the patentee claims, as having first applied it to the purpose stated.

A machine for thrashing, or clearing grain, from the straw of rice, and other substances; Asa Nourse, Beaufort, South Carolina, July 19.

This thrashing machine resembles, in its form, the common grist mill, but instead of stones, there are two thick framed wooden wheels; these lie horizontally, the lower one, which is 7 feet in diameter, being made to turn by a spindle, which passes through a large eye, or opening, in the upper one, which eye is 34 inches in diameter. The faces of these wheels are furnished with strips of iron, forming ridges which raise ½ inch above their surfaces. These strips radiate from the centre, but do not coincide, those upon the upper wheel varying 3 degrees from the centre. The sheaves are put in at the eye of the upper wheel, and the grain is delivered at an opening in the rim. There are some other appendages, as knives for cutting the bands, &c.; but the parts described are the principal.

Improving and facilitating the means of transport, and conveyance of goods and passengers; John I. Reekers, Baltimore, Maryland, July 21.

The specification states, that "this invention or improvement, consists in covering the whole surface on which the transport is to be made, with sheets of iron, or other metal, or composition of metals, or ore, of the requisite thickness, by fixing them on the road, or way, in ready made plates, slabs, or pieces; or by spreading the smelted metals, or ores, over the whole extent of road, or surface intended to be used."

Such a road, it is suggested, may become a substitute for rail-roads, canals, and common roads. How the *plates*, *slabs*, or *pieces*, are to be fixed and secured, upon a foundation of sand, clay, and soil, we are not informed; but must presume, that the patentee has a clear idea of these things in his own mind: we are still more at a loss, to perceive how he intends to *spread the smelted metals, or ores*,

over the whole extent of the road. Should he think proper to favour us with clear views upon these points, we shall be happy to lay them before the readers of our Journal.

A machine called the 'universal drub,' for thrashing, or separating, by rubbing, the seed or kernel of all kinds of grain from the straw; Samson Felton, Killbuck township, Holmes County, Ohio, July 22.

The grain is placed upon an apron, and is carried between a cylinder, and a case where the seed is rubbed out. The cylinder is of metal, punched from the inside, like a grater. The case is perforated with holes, through which the seed passes, whilst the straw is carried off, and delivered from another part of the machine. The patentee claims, 1st. The simultaneous revolving and vibrating motion of the roller and case, producing the necessary rubbing.

2nd. The mode of increasing the vibration when the grain is damp, and *vice versa.*

3d. The general arrangement as it contributes to these ends.

A machine for manufacturing siding lath, and other lumber; Levi Rice, Lockport, Niagara County, New York, July 23.

A stock is fixed in a frame, in which it slides freely backward and forward. It is moved by a cog wheel, which works in cogs on one side of the stock, in the manner of a rack and pinion. A knife is fixed upon the stock, and the timber to be cut into laths, &c. is fixed in a frame and is made to bear against the stock, and the lath is cut by the traversing motion of the stock. The knife, it is said, may have a double edge, so as to cut a lath both by the forward and backward stroke.

A self-acting press for pressing cheese, &c.; David Hitchcock, of New York, and Chester Stone, of New Haven County, Connecticut, July 24.

This invention we intend hereafter to give, with the engravings which are requisite to make it properly understood.

Cloth for the boots of stages, and other purposes; Peter Laporte, Augusta County, Virginia, July 28.

This cloth is composed of hemp and wire, the hemp being twisted lightly round the wire, and the whole then woven in the manner of common cloth. This is to be covered with paint, and it is proposed, to use it for boots of stages, for carpeting, sacking-bottoms, pannels, bodies, and tops of carriages, &c.

Machine for feeding cotton-gins with seed cotton; Joseph Eubank, jun., Glasgow, Barren County, Kentucky, July 29.

To feed the cotton gin, for the purpose of cleaning the cotton from the seed, there is to be a feed apron, similar to that used in the machine for carding; this apron is carried forward with the requisite velocity, and at the end towards the saws, there is a roller, or cylinder, extending across the whole width of the apron. This cylinder is set with teeth, or fangs, formed of iron wire, and is made to re-

volve so as to feed the saws, by carrying the seed from the apron against them.

An improved corn-shelling machine; Philip Grosjean, Louisville, Kentucky. He having resided two years in the United States. July 29.

This shelling machine resembles that of Evans, as is acknowledged in the specification; that is, there is a vertical wheel, with ridges, or teeth, against which the corn is to be borne by a spring. The patentee proposes to give greater velocity to the wheel than in the former machine, the cog wheel and pinion intended to effect this, being to each other as 18 to 4. This wheel and pinion are fixed in a frame, attached to, but distinct from, that of the shelling wheel. The increased velocity, and the distinct frame, are the improvements claimed.

Improvement in the steam distillery; Thomas Lawes, and Philip Grosjean, Louisville, Kentucky, July 30.

The particular arrangement of the pipes, worms, tubs, flues, &c., described by the patentees, cannot be clearly explained without the drawings; and the specification does not seem to us, to point out distinctly, in what the particular improvements claimed, consist.

Making hammers of cast iron; Thomas Jones, Glastonbury, Hartford County, Connecticut, July 31.

In preparing to cast the hammers, a piece of iron is moulded with the pattern, against which iron the face of the cast hammer is run, and is consequently chilled and hardened. A small piece is also placed in the mould to come in contact with the claw. The hammers, after being cast, are to be ground, and polished upon a buff.

Improvement upon Phineas Slayton's machine for sawing hoops, lath, basket stuff, stuff for making riddles, window curtains, and window blinds; Nicholas Bratt, of Lockport, New York, July 31.

The stuff is to be sawed out by gangs of circular saws, fixed upon spindles, at suitable distances from each other. The manner of gearing adopted by the patentee, it is unnecessary to explain; the principal novelty in it, appears to us, to be the using of two drums on opposite sides of the shaft or spindle which carries the circular saws; instead of one broad, there are several narrow straps passing over the spindle from each drum, and the friction is said to be lessened, and other advantages gained, by this arrangement.

LIST OF FRENCH PATENTS

Granted by the French Government, from 1st of July, to 30th September, 1827.

To Paret, Pierre Joseph, mechanic, of Montpellier, for new weighing machines—15 years.

To Landrieu, Jean Baptiste Joseph, son & Co. of Anzin, for improvements in making bricks—5 years.

To Roland de Bussy, Jean François, of Paris, for a kiln for carbonizing peat or turf—10 years.

To Moussier, Rene Louis, toyman, Paris, for a sulphuretted diamond cut file, for taking away corns and bunions—5 years.

To Carpentier, Parfait-Modeste, Paris, for a mechanical bed and arm-chair upon springs, for sick people—15 years.

To Berry, Henry, merchant, London, for an elastic cork, made of *caoutchouc*, or Indian gum, and for certain improvements in the combination of, and application of, an apparatus for procuring instantaneous light—10 years.

To Ferry, Jean Nicholas, locksmith, of Epinal, Vosges, for improvements in the portative scales, by Quinteriz—5 years.

To Ensgraber, Leopold, Cooper and Brewer, of Channy, for a cooling ventilator—5 years.

To Jamin, Louis François, and Cordier, François Romi, button makers, Paris, for the invention and application of dyed leather of all colours for making buttons—5 years.

To Gamvin, Archange, of Paris, for a method of obtaining steam without fear of explosion, with great reduction in space, weight, and expense—15 years.

To Lagrange, Louis Benjamin, merchant, Paris, for a method of clarifying liquor—10 years.

To Pradel, Pierre, clock-maker, of Carcassonne, Aude, for a machine for shearing cloths—10 years.

To Jolly, Victor, and Ewbank, Bruno, chemists, at la Glacier, for a process for carbonizing turf—5 years.

To Mullens, Paris, for an elastic mattrass, and other furniture—15 years.

To Gurzot, Louis, architect, Paris, for a crane for removing the earth out of canals, &c. and for supplying it where wanted, for fortifications—15 years.

To Lesgent, junior, pewter pot maker, Paris, for the invention of a metal mixed with steel, for making spoons, &c. and possessing all the strength, elasticity, and polish of silver—10 years.

To Rey, Etienne, drawing master, of Lyons, and Aguettant, Sebastian, architect, of la Guillotiere, Rhone, for the application of the force of water, wind, and steam, in erecting bridges and other works —10 years.

To Munch, Jean Philippe Geoffroi, saddler and coach maker, Strasbourg, for a carriage, which it is impossible to upset—5 years.

To Napier, Charles, captain in the English Navy, and Polonceau, Antoine Rimi, Versailles, engineer, for a system of floating bars, for the navigation of rivers—10 years.

To Revon, Pierre, mechanic, Paris, for the invention of a steam engine, adapted to carriages and boats of all kinds and dimensions —10 years.

To Girard, Jean Joseph, locksmith, of Bagnols, Gard, for a cotton spinning machine—5 years.

To Bouchet Roudier, Jean, merchant, Nismes, Gard, for a method

of working, by a combination of levers, set in movement by manual labour, a variety of machines, in cotton spinning manufactories, mills, &c.—5 years.

To Tourmer, Miss Francoise Pauline, milliner, Paris, for rolls worn round the heads of children, made of whalebone, and called *Bonnelets Hijgieniques*—5 years.

To Decrouan, Michel François Denis, engraver, Paris, for a method of engraving upon linen, called *Tableaux Chalchographies*—5 years.

To Guerin de Fouein & Co. Paris, for an economical method of producing sulphuric acid—15 years.

To Hany, Guillaume, Boulogne-sur-mer, for the invention of one or more cylinders, to be adapted to atmospheric and condensing steam engines—15 years.

To Lepine, Paris, for a new invented lamp, and incombustible wick—5 years.

To Revillon, Thomas, Macon, for a wine press, acting by means of a pendulum, and for the application of the pendulum to mechanics—15 years.

To Penot, Jean Henri Achille, professor of chemistry, of Mulhause, Upper Rhine, for a method of obtaining sub-carbonate, acetate, nitrate, and hydro-chlorate of lead—15 years.

To Peyron, Jean Louis, and Augier, Louis Andre, merchants, of Montelimer, Drome, for a machine for thrashing and winnowing grain —10 years.

To Gervais, Paris, for a method of improving wines, brandies, and other spiritous liquors, by means of heat—10 years.

To Bouche, Dennis Joseph, Paris, for a machine for dressing cloth and other stuffs—10 years.

To Vallon, Pierre, cutler, Paris, for an artificial whet-stone, for sharpening razors—5 years.

To Martin, Ferdinand, surgeon, Paris, for a mechanical elastic bed for extending the spine or vertebral column—5 years.

To Vieville de Clanlieux, Paris, for a combing machine—15 years.

To Adam, Jaques François, Paris, for a moveable binding, adapted to public and other registers—10 years.

To Carswell, Messrs. Alexander and Robert, Greenworth, Scotland, for improvements in the building of vessels moved by machinery acting upon water—15 years.

To Berthault, Claude Jean Baptiste Alexandre, engineer, Chalons, for the invention of water proof cement—15 years.

To Pebezis, Pierre Jacques, geographical engineer, Paris, for the invention of an easy bed or bathing tub, called *baignoires dormeuses* —10 years.

To Poulliot, Jean Jerome, Paris, for a pneumatic regulator, adapted to hydrogen gas apparatus—5 years.

To Pepigne, Antoine, Paris, for a filtering machine—10 years.

[TO BE CONTINUED.]

The second article on the luminous appearance of the ocean, referred to in page 164, has been mislaid.